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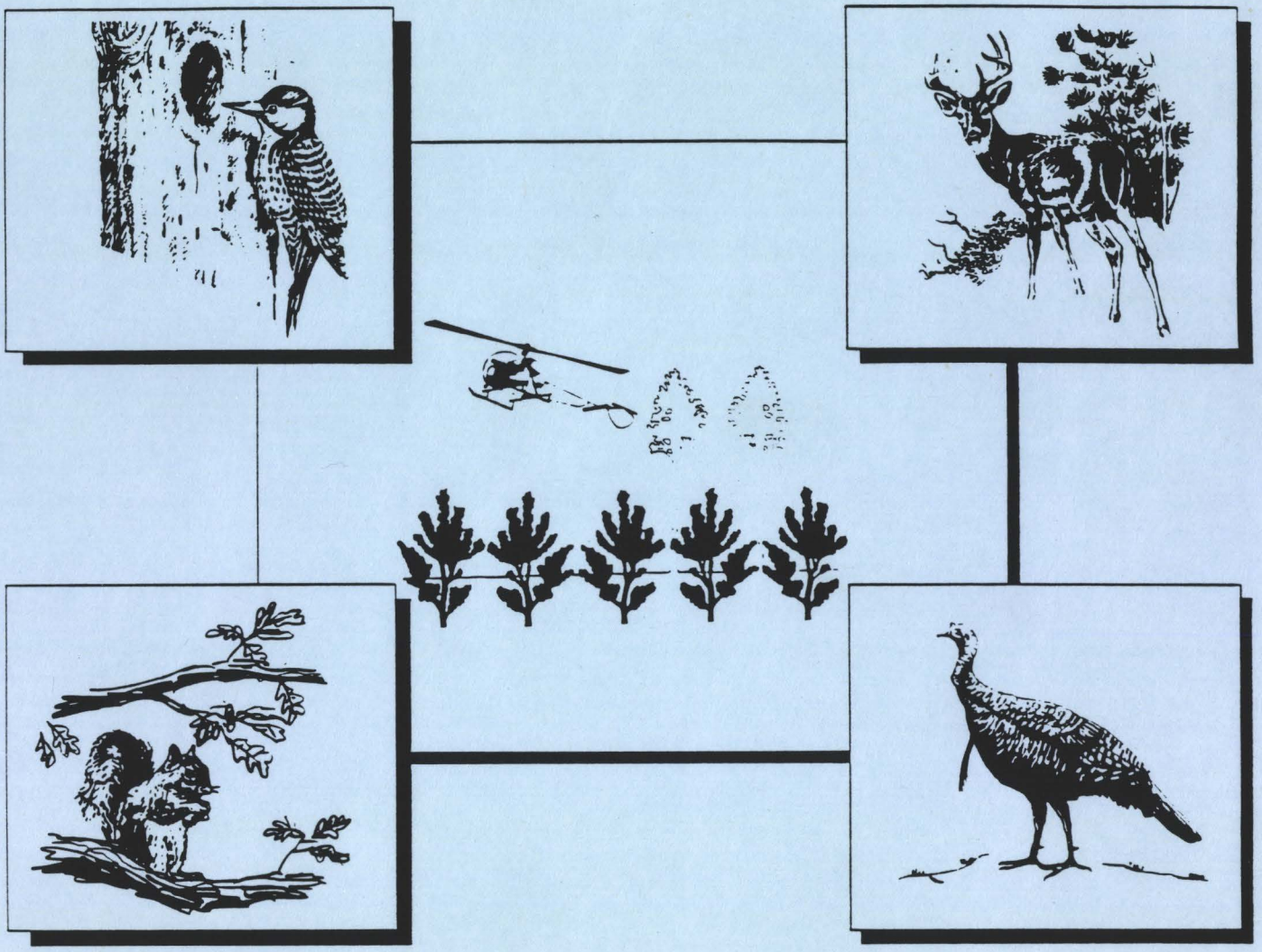
Technical
Publication R8-TP 13
Revised September 1996

Herbicides and Wildlife Habitat (1954-1996)

An Annotated Bibliography on the Effects of Herbicides on Wildlife Habitat and Their Uses in Habitat Management



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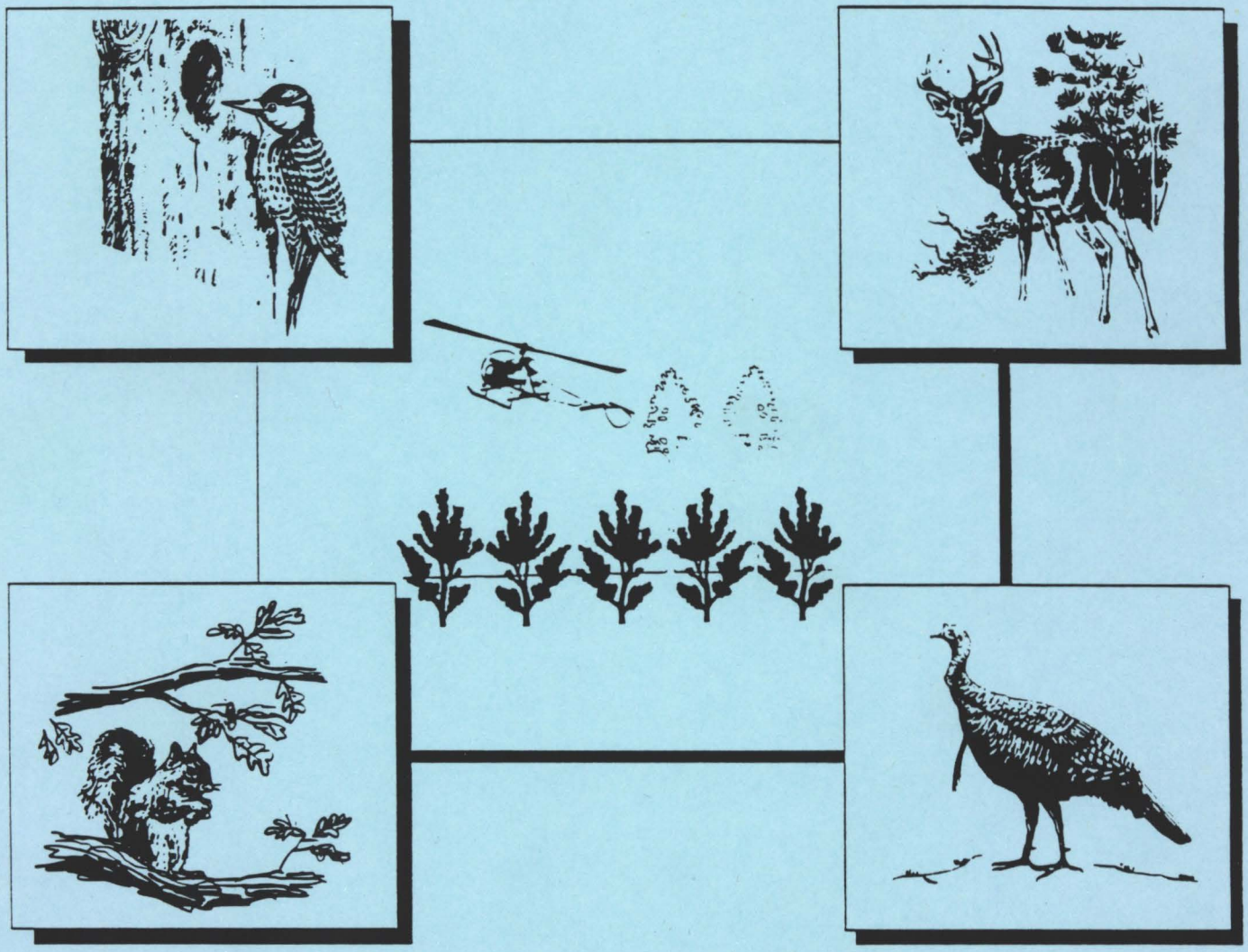

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HERBICIDES AND WILDLIFE HABITAT (1954-1996)

An annotated bibliography on the effects of herbicides on wildlife habitat and their uses in habitat management

Doug L. Howell[1]
School of Forest Resources, University of Georgia
Athens, Georgia

Karl V. Miller
School of Forest Resources, University of Georgia
Athens, Georgia

Parshall B. Bush
Cooperative Extension Service, University of Georgia
Athens, Georgia

John W. Taylor
Forest Health, USDA Forest Service
Atlanta, Georgia

USDA Forest Service
Southern Region
1720 Peachtree Rd., N.W.
Atlanta, Georgia 30367-9102

United States
Department of Agriculture
Forest Service

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[1]Present Address: Directorate of Public Works and the Environment, AFZA-PW-DW Wildlife Branch, Fort Bragg, North Carolina, 28307-5000.

HERBICIDES AND WILDLIFE HABITAT (1954-1996)

An annotated bibliography on the effects of herbicides on

wildlife habitat and their uses in habitat management

Vegetation control with herbicides is a common practice in forest, range, and right-of-way management throughout the United States. Herbicide use has increased in the past decade for several reasons:

1. increased availability of more selective and environmentally compatible chemicals,
2. rising costs of alternative vegetation control methods such as mechanical site preparation,
3. lack of labor to conduct manual vegetation control, and
4. recognition that herbaceous and woody plant competition reduces early growth of newly established plantations.

Structure and composition of vegetation are primary factors governing the distribution and abundance of wildlife. Species richness and composition are related to the vertical and horizontal diversity of vegetation. Various classes of herbicides affect plant species composition differently resulting in varied responses of wildlife to herbicide-induced habitat changes. The effects of herbicidal vegetation management may be positive or negative, depending on the particular wildlife species and its habitat requirements. Sound management decisions with considerations for wildlife require that vegetation managers have adequate information on herbicide/habitat interactions for each wildlife species.

This annotated bibliography is a compilation of published reports (1954-1996) on the effects of herbicides on wildlife habitat. The use of herbicides in wildlife habitat management is also included. Geographically, this bibliography covers the continental United States and Canada. A few pertinent publications from other geographic regions have been included.

This compilation will aid managers in determining the wildlife implications of vegetation management activities on wildlife species and also assist researchers in identifying research needs. It is intended to supplement the original publication of Miller et al. 1989, *Herbicides and Wildlife Habitat: An Annotated Bibliography on the Effects of Herbicides on Wildlife Habitat and Their Uses in Habitat Management*, United States Department of Agriculture, Forest Service, Technical Publication R8-TP 13.

Annotations consist of abstracts, conclusions, or summaries from the original reference. In some instances, comments indicating specific herbicides used or wildlife species affected have been inserted. All comments or additions not appearing in the original report have been placed in brackets [ ]. Publications without abstracts, conclusions, or summaries are abstracted by the authors (DLH, KVM). In some instances the original abstracts or summaries have been abbreviated. Deleted portions are indicated by a series of three dots (...). Do not cite information from the abstracts; always refer to the original source.

References are indexed by author, wildlife species, plant species, primary land use, and herbicide. An appendix listing approved common names and product names of herbicides mentioned in this bibliography also has been included.

In addition to the printed version, this bibliography is also available on 3.5" diskettes as an ASCII text or WordPerfect file. Requests for diskettes should be sent to:

Karl V. Miller
D. B. Warnell School of Forest Resources
University of Georgia
Athens, GA 30602
email: KMILLER@SMOKEY.FORESTRY.UGA.EDU

Citation Number 1

Allen, D. L. 1954. Wildlife habitat in relation to the use of herbicide sprays on farms, ranches, and roadsides. International Association of Game, Fish and Conservation Commissions 43:90-94.

The relationship of herbicide techniques to the preservation and improvement of wildlife habitats is a field which we have only begun to explore. Widespread intensive use of the land is so far ahead of our wildlife management knowledge that the verdict is quite likely to be too little too late. If we are interested in having game and other creatures considered in large herbicide operations, it is time now to get busy and develop a basis of workable techniques on which realistic recommendations can be made. [Recommendations for mitigating the wildlife impacts of vegetative management with herbicides and examples of the use of herbicides to improve wildlife habitat are provided.] (Author's conclusions)

Citation Number 2

Amman, G. A. 1963. Status and management of sharp-tailed grouse in Michigan. Journal of Wildlife Management 27:802-809.

Sharp-tailed grouse (*Pedioecetes phasianellus*) have decreased at least 9 percent in the Upper Peninsula of Michigan since 1956, largely a reflection of the loss of habitat. ... Positive management measures on sharptails totaled 6,953 acres purposely burned and 10,849 acres sprayed with herbicide. Spraying or a combination of burning and spraying, where feasible, is the most practical measure for controlling woody cover. Sixteen-, 17-, and 18-year histories of sharptail populations on several areas that were repeatedly treated by burning and spraying showed varying responses by the sharptails but proved that sharptail populations can at least be maintained by intensive management-at a price. In the future, sharptails will very likely be restricted to a few productive and intensively managed areas. (Author's abstract)

Citation Number 3

Anderson, A. E. 1969. 2,4-D, sagebrush, and mule deer - cattle use of upper winter range. Colorado Division of Game, Fish and Parks, Special Report 21. 21pp.

Eight, disjunct, sagebrush (*Artemisia tridentata* spp.) communities totaling 731 acres ... were aerially sprayed with 2,4-D. ... Mean, air-dry sagebrush forage yields were reduced [on both completely and partially sprayed areas]. Percent frequencies of grass and grasslike genera nearly doubled for all sagebrush thus treated. All forbs ... were reduced in percent frequency. The accidental loss of control areas, other habitat modification adjacent to the sampled area, and several unmeasured but pertinent variables permit only tentative interpretation of the changes described [in deer and cattle use] as being causally related to 2,4-D treatment. (Author's abstract)

Citation Number 4

Anthony, R. G., and M. L. Morrison. 1985. Influence of glyphosate herbicide on small mammal populations in western Oregon. Northwest Science 59:159-168.

The effect of glyphosate application on vegetation and small mammal populations in the Coast Range of western Oregon was investigated. Diversity, abundance, and biomass of small-mammal populations increased one year post-spray on glyphosate-treated sites as compared to control sites. These changes were ephemeral and the above parameters were similar to pre-spray values two years after glyphosate application. The changes in diversity, abundance, and biomass were primarily a result of the increase in numbers of *Microtus oregoni* following an increase in grass and forb cover on treated grids one year post-spray. The temporary effects of glyphosate treatment on vegetation had no detrimental effects on small mammal populations. (Authors' abstract)

Citation Number 5

Arner, D. H. 1960. Effects of rights of way techniques on vegetation. Transactions of the North American Wildlife and Natural Resource Conference 25:378-386.

[Right-of-way vegetation management by spraying with 2,4-D or 2,4,5-T, hand-cutting, mechanical cutting, or bulldozing all failed to fill the important requirements for deer and turkey of a palatable, nutritious early spring green. Various techniques of vegetation management and seeding were tested to find techniques that would retard the invasion of woody plants and provide highly nutritious foods for wildlife.] A greater amount of nutritious wildlife food can be produced and a more economical reduction of woody vegetation can be obtained through the use of mechanical equipment or controlled burning when these treatments are combined with the application of fertilizer and seed, than any other technique now in current use. Before selecting the techniques to be used in right of way management, topographic conditions, types, and quantity of vegetation present, width of right of way, and the landowners' desires will all have to be taken into consideration. (KVM abstract)

Citation Number 6

Arner, D.H. 1966. Utility line right-of-way management. Transactions of North American Wildlife and Natural Resource Conference 31:259-268.

Cooperative work between the Maryland Game Commission and a power company was initiated in 1948 and cooperative planning was started in Alabama in 1958. Information gleaned from these projects has pointed the way for reduced right-of-way maintenance costs as well as reduced costs for establishment of feeding areas for forest game species. The technique of spraying with herbicides is strongly entrenched in maintenance work of utility companies. [Seeding recommendations, maintenance schedules, and cost estimates are provided.] (KVM abstract)

Citation Number 7

Balfour, P. M. 1989. Effects of forest herbicides on some important wildlife forage species. Canada-British Colombia Forest Resource Development Agreement, Report 020. 58pp.

The purpose of this report was to consolidate information on the effect of forest herbicides on important wildlife forage species by reviewing herbicide trial results from British Columbia, Alberta, Saskatchewan, Washington, Oregon, and Idaho. The effect of herbicides, including glyphosate, hexazinone, 2,4-D amine, 2,4-D ester, and triclopyr ester on major wildlife forage species, including conifers, deciduous trees, shrubs, sedges, and grasses was evaluated. (DLH abstract)

Citation Number 8

Ball, E.W. 1958. Results in applying dalapon by aircraft to pest plants in waterfowl areas of the Southeast. Down-To-Earth 14:11-14

[Between 1954 and 1956, 136 acres of *Typha* spp., 16 acres of *Panicum hemitomon*, and 6 acres of *Zizaniopsis miliacea* were treated with an aerial application of dalapon. Treatment areas included St. Marks, Loxahatchee, Savannah, Mattamuskeet, and Pea Island National Wildlife Refuges.] Results of these experiments indicated that dalapon applied by aircraft shows definite promise in controlling two of these species with some indication the third species might be controlled under modified conditions. (KVM abstract)

Citation Number 9

Ball, E. W. 1959. Aerial treatment of pest plants with herbicides on national wildlife refuges in the Southeast. Proceedings of the Annual Conference of the Southeast Association of Game and Fish Commissioners 13:259-267.

[This paper summarizes the results of herbicides applied by aircraft to several pest plants in freshwater waterfowl impoundments on several National Wildlife Refuges in the Southeast. Plants sprayed include *Typha* spp., *Sesbania macrocarpa*, *Nelumbo pentapetala*, *Raphanus* spp., *Alternanthera philoxeroides*, *Juncus roemerianus*, *Eichornia crassipes*, *Jussiaea grandiflora*, *Nymphaea odorata*, *Sagittaria lancifolia*, *Panicum hemitomon*, *Melochia corchorifolia*, *Nuphar advena*, *Zizaniopsis miliacea*, *Jussiaea diffusa*, *Salix* spp., *Myrica cerifera*, *Baccharis halimifolia*, and *Borrichia frutescens*. Treatements included 2,4-D, dalapon, amitrol, and silvex. Treatment times are provided.] (KVM abstract)

Citation Number 10

Barrons, K. C. 1969. Some ecological benefits of woody plant control with herbicides. Science 165:465-468.

[The ecological effects of 2,4-D, 2,4,5-T, silvex, and Tordon are reviewed. The research of Bramble and Byrnes (1967) is discussed. The author concludes that selective herbicides have given man new tools which have certain ecological as well as economic advantages.] (KVM abstract)

Citation Number 11

Barrons, K. C. 1973. Some environmental benefits of herbicides. Down-To-Earth 29:30-32.

In addition to the economic values, there are a number of environmental benefits associated with the use of herbicides which are seldom considered. In a number of instances, herbicides have proven useful for the selective inhibition of plants that are, in one way or another, undesirable components of a habitat favorable for the wildlife species of interest. [Several references on the beneficial effects of herbicides on various wildlife species are provided.] (KVM abstract)

Citation Number 12

Beasom, S. L., C. J. Scifres, and M. Brownfield. 1975. Reaction of white-tailed deer populations to aerial applications of herbicides in the South Texas mixed brush. Rangeland Resources Research: Consolidated Progress Report 1971-1974, PR-3. Vol 13:51.

Aerial spraying 80% of a mature honey mesquite brushland in alternating strips with 2,4,5-T + picloram (1:1) at 1.12 kg/ha did not adversely affect populations of white-tailed deer. Deer populations on the Treatment 1 Area (80% spray) did not change significantly throughout the counting period. On the Treatment 2 Area (total spray) deer density was reduced by more than 50% by August of the year following treatment. These data indicate that it is possible to aerially spray as much as 80% of mature mesquite brushland [in alternating strips] with no adverse effects on white-tailed deer populations. Important factors to consider in addition to amount of brush treated, however, are pattern, timing, effectiveness, and type of control treatment administered. Sprayed strips wider than those used in this study [550-600 ft separated by 100 ft untreated strips] might have had a detrimental effect on the deer. Conversely, there might have been a beneficial effect if more, narrower strips had been used. (KVM abstract)

Citation Number 13

Beasom, S. L., and C. J. Scifres. 1977. Population reactions of selected game species to aerial herbicide applications. Journal of Range Management 30:138-142.

Aerial spraying 80% of a mature honey mesquite brushland in alternating strips with 2,4,5-T + picloram (1:1) at 1.12 kg/ha did not adversely affect populations of white-tailed deer, nilgai antelope, wild

turkeys, or feral hogs. Complete treatment (100% sprayed) apparently exceeded the threshold of suitability for all game species surveyed except nilgai antelope. White-tailed deer densities were inversely correlated with production and species diversity of forb populations following aerial spraying. With restoration of the forbs at 27 months after treatment, there were no differences among treatments in deer numbers. Javelina populations, apparently as a result of controlling pricklypear, were significantly reduced by both spray treatments. Reductions in javelina densities were apparent at the final census, 27 months after herbicide application. (Authors' abstract)

Citation Number 14

Beasom, S. L., J. M. Inglis, and C. E. Scifres. 1982. Vegetation and white-tailed deer responses to herbicide treatment of a mesquite drainage habitat type. Journal of Range Management 35:790-794.

A honey-mesquite drainage habitat [in eastern LaSalle County, Texas] ... was aerially sprayed with 1.1 kg/ha of 2,4,5-T + picloram in the spring. Adjacent habitats ... were not sprayed. Discriminant treatment of the honey mesquite drainage habitat did not cause consistent differences in white-tailed deer use of that habitat nor did it change deer use of the pasture containing the sprayed drainage ... for 22.5 months after herbicide application. Lack of differences in deer use between sprayed and unsprayed habitats were attributed to minor impacts of sprays on forb populations during the study period, retention of ample cover screen for deer, and increased abundance of grasses on sprayed areas which presumably reduced use of preferred deer food items by cattle. (Authors' abstract)

Citation Number 15

Beaver, D. L. 1976. Avian populations in herbicide treated brush fields. Auk 93:543-553.

[Avian populations in 2 areas of a brush field in Nevada County, California were compared before and after herbicide treatment (2,4,5-T @ 0.72, Plot 1, or 0.54 kg/ha, Plot 2).] The relative abundance of certain species was noted to change between pre- and post-spray periods on both plots. No effect of herbicide treatment was discernible on avian species composition, population size, or relative abundance on Plot 1 with 2-year post-spray nor on Plot 2 1-year post-spray. In this study, changes in food type and abundance on herbicide sprayed plots resulted in no noticeable short-term population changes. (KVM abstract)

Citation Number 16

Beck, R. 1957. Herbicides increase game foods and edge in solid stands of phragmites. Down-To-Earth 12:2-3.

Radapon application to control phragmites yielded a bonus in increasing game food and cover. Plants which followed the phragmites proved to be of high value to game and their numbers increased markedly. Seeding desirable plants after phragmites control proved unnecessary because of the abundance of food-producing plants which volunteered on the land. (Editor's abstract)

Citation Number 17

Beck, R. A. 1971. Phragmites control for urban, industrial, and wildlife needs. Proceedings of the Northeast Weed Science Society 25:89-90.

The creation of edge and interspersion in solid stands of phragmites can be a major means of improving habitat for wildlife as well as preventing damage from fires. Treatment depends on the wetness of the site and the maturity stage of the plant. Effective rates of amitrole-T, dalapon, amitrole-T + dalapon, and erbon are provided for dry, dry-wet, and flooded/tidal areas.] (KVM abstract)

Citation Number 18

Beeman, L., and R. K. Schreiber. 1976. A partial bibliography - environmental concerns in rights-of-way management. Pp. 321-335 *in* R.E. Tillman, ed. Proceedings of the First National Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

[A list of references pertaining to both direct and indirect ecological impacts associated with rights-of-way construction and maintenance is provided. References are arranged into general impacts, right-of-way construction and vegetation management, impacts on wildlife (terrestrial and aquatic), and biological effects.] (KVM abstract)

Citation Number 19

Bellrose, F. C. 1956. The control of aquatic weeds in waterfowl habitats. Proceedings of the North Central Weed Control Conference 13:26.

The aerial application of herbicides appears to be a feasible method of controlling some of the undesirable plants in waterfowl habitats in Illinois. Highly satisfactory results were obtained in using 2,4-D to control American lotus (*Nelumbo lutea*), white-water lily (*Nymphaea advena*), and black-willow (*Salix nigra*), and possibly buttonbush (*Cephalanthus occidentalis*). The aerial application of radapon on cattail beds did not effect a complete kill [probably due to incomplete coverage. Reduction of undesirables resulted in rapid reinvasion of desirable duck food plants such as coontail (*Cerataphyllum demersum*), rice cut-grass (*Leersia oryzoides*) and duck potato (*Sagittaria latifolia*).] (KVM abstract)

Citation Number 20

Besadny, C. D., C. Kabat and A. J. Rusch. 1968. Practical aspects of a selective brush management program on Wisconsin roadsides. Transactions of the North American Wildlife and Natural Resources Conference 33: 236-249.

A selective brush management program was designed to increase the esthetic quality of the country road, make management of roadside rights-of-way easier, help reduce soil erosion, and provide wildlife food and cover. [Treatments consisted of combinations of selective cutting and selective spraying with 2,4-D or 2,4,5-T to retain existing low-growing shrubs and remove trees and other undesirable vegetation. Although no intensive efforts have been made to evaluate the effects of the program on wildlife, observations indicate heavy use of the managed hedgerows by songbirds, rabbits, and pollinating insects. Some use by pheasants, especially for winter cover, was recorded.] (KVM abstract)

Citation Number 21

Best, L. B. 1972. First-year effects of sagebrush control on two sparrows. Journal of Wildlife Management 36:534-544.

This study, conducted in central Montana during the summers of 1968 and 1969, was designed to examine effects of sagebrush (*Artemisia tridentata*) control on two nongame birds: Brewer's sparrows (*Spizella breweri*) and vesper sparrows (*Pooecetes gramineus*). Plots were ... subjected to five treatments: total kill spray, strip spray, partial kill spray, defer control, and open control. Plots were sprayed with 2,4-D in late June 1968 ... Only on the total kill spray plot did breeding pairs of Brewer's sparrows notably decline (54%) after spraying. No significant change occurred in pairs of vesper sparrows ... Plant foods (primarily grass seeds) represented a greater portion of the diets of both sparrows on the sprayed area than on the unsprayed area. ... As a result of spraying, major plant and animal foods that were consumed differed in amount rather than in variety. Dependence upon sagebrush for nest cover will be a major factor determining the ultimate effects of sagebrush control on Brewer's and vesper sparrows. (Author's abstract)

Citation Number 22

Blake, F. M. 1986. Plant biomass, plant species composition and pine tree characteristics for a banded versus broadcast hexazinone treated pine plantation. M.S. Thesis, Mississippi State University, Mississippi State. 50pp.

Vegetative responses, white-tailed deer (*Odocoileus virginianus*) forage, and loblolly pine (*Pinus taeda*) seedling survival, growth, tipmoth and fusiform rust incidence were compared in the first 2 field growing seasons of a loblolly pine plantation in the Interior Flatwoods in Oktibbeha County, Mississippi following banded and broadcast application of hexazinone. ... In the first growing season, for total summer plant biomass, summer and winter deer forage abundance, and pine seedling variables ... there was no significant difference (P=0.10) between the 2 herbicide treatments, but the controls differed significantly from both herbicide treatments. ... In the second season, ... there was no significant difference (P=0.10) among the 3 treatments. ... A similar number of plant species was found on each of the 3 treatments. Vegetation data indicate a rapid recovery of vegetation in the hexazinone treatments in the second field growing season. (Author's abstract)

Citation Number 23

Blake, P. M. 1986. Diversity, biomass, and deer forage in banded versus broadcast hexazinone in a loblolly pine plantation. Proceedings of the Southern Weed Science Society 39:404.

The effect of the application of hexazinone to control herbaceous competition in newly established loblolly pine (*Pinus taeda*) plantations on deer forage was investigated. A flatwoods site in Oktibbeha Co., Miss. received either Velpar L @ 1.12 kg ai/ha, Pronone 5G @ 1.12 kg ai/ha or were left untreated. No significant differences between the two application methods were observed in total biomass at the end of the first growing season or in summer and winter deer forage. Controls differed significantly (P = 0.10) from treatments in the first growing season. In the second growing season there was no significant difference between any of the treatments. (KVM abstract)

Citation Number 24

Blake, P. M., G. A. Hurst, and T. A. Thomas. 1987. Responses of vegetation and deer forage following application of hexazinone. Southern Journal of Applied Forestry 11:176-180.

Vegetation responses were studied on a loblolly pine (*Pinus taeda*) plantation that had received intensive mechanical site preparation and hexazinone (1 lb/ac a.i.) for herbaceous weed control. Vegetation on plots treated by a broadcast application of granular hexazinone (Pronone 5G) was compared to vegetation on plots that received a banded (top of bed only) application of liquid hexazinone (Velpar L). ... White-tailed deer (*Odocoileus virginianus*) forage was significantly greater on control plots (1,481 lb/ac) than on broadcast (393 lb/ac) and banded plots (534 lb/ac) in September of the first year's growth, but there were no differences after the second growing season. ... (Authors' summary)

Citation Number 25

Blixt, D. C. 1993. Effects of glyphosate-induced habitat alteration on birds, using wetlands. M.S. Thesis, North Dakota State University, Fargo. 127pp.

The effects of wetland habitat alteration [50%, 70%, and 90% areal coverage with glyphosate herbicide or untreated controls] on the populations of 8 bird species and 4 bird groups were studied in northeastern North Dakota, during June, July, and August 1990-1992. ... The herbicide successfully reduced live emergent vegetation in all treated wetlands. The 70% and 90% areal spray coverages negatively influenced numbers of marsh wrens (*Cistothorus palustris*) and red-winged blackbirds (*Agelaius phoeniceus*). Numbers of common yellowthroats (*Geothlypis trichas*) decreased following 90% spray coverage. Generally, waterfowl (Anatidae) numbers did not differ among treatments. The numbers of

yellow-headed blackbirds (*Xanthocephalus xanthocephalus*), song sparrows (*Melospiza melodia*), mallards (*Anas platyrhynchos*), blue-winged teal (*A. discors*), gadwalls (*A. strepera*), rails (Rallidae), and sparrows (Emberizinae) did not respond to the herbicide treatments. Shorebirds (Scolopacidae, Charadriidae, and Recurvirostridae) generally showed higher abundances in the herbicide-treated wetlands than in the control wetlands during July and August. Thus, glyphosate may be a useful management tool for restoring cattail-choked wetlands. (Author's abstract)

Citation Number 26
Borrecco, J. E., H. C. Black, and E. F. Hooven. 1972. Response of black-tailed deer to herbicide-induced habitat changes. Proceedings of the Annual Conference, Western Association of State Game and Fish Commissioners 52:437-451.

... Half of [three areas in western Oregon] was treated with a combination of herbicides, principally Atrazine and 2,4-D, to control herbaceous vegetation. Small mammals were live-trapped, deer pellets counted, browsing damage to Douglas-fir observed, and vegetation analyzed on both treated and untreated areas. ... The most important results were a reduction in number of species, chiefly grasses and forbs, and in ground cover on treated areas. ...Trapping before and after treatment showed no acute effects to small mammal populations. With effective control of vegetation, however, the abundance and relative species composition of small-mammal populations were altered. Responses to changes in vegetation depend on habitat preferences. ... Significantly more [deer] pellet groups were counted on treated plots during the growing season than on untreated plots. ... (Authors' abstract)

Citation Number 27
Borrecco, J. E. 1973. The response of animals to herbicide-induced habitat changes. M.S. Thesis, Oregon State University, Corvallis. 92pp.

See Borrecco et al. (1972).

Citation Number 28
Borrecco, J. E., H. C. Black, and E. F. Hooven. 1979. Response of small mammals to herbicide induced habitat changes. Northwest Science 53:97-106.

Halves of three clearcuttings in western Oregon were treated in the springs of 1970 and 1971 with a combination of herbicides, principally atrazine and 2,4-D, to control herbaceous vegetation.. ... Herbicide treatments reduced the numbers of plant species, chiefly grasses and forbs, and ground cover. ... *Microtus oregoni*, *Peromyscus maniculatus*, *Sorex vagrans*, *Sorex trowbridgii*, and *Zapus trinotatus* - comprising 95% of the total small mammal community - were abundant enough for meaningful evaluation. Mark-recapture data showed that the kinds and numbers of small mammals were similar between the sides of each designated area before treatment. However, effective control of herbaceous vegetation altered the species composition of small mammal communities as they responded according to their habitat preferences. Species preferring grassy habitats were less abundant on treated than untreated plots. (Authors' abstract)

Citation Number 29
Bovey, R. W., and J. D. Diaz-Colon. 1978. Selected bibliography of the phenoxy herbicides. IV. Ecological effects. Texas Agricultural Experiment Station, Miscellaneous Paper 1360. 28pp.

[In this bibliography, the authors provide some of the more pertinent references to phenoxy herbicide use and environmental effects. Citations for 196 references are provided and are indexed by herbicide and the type of ecosystem affected. Herbicides listed include: 2,4-D, MCPA, MCPB, mecoprop, 2,4,5-T, and silvex.] (KVM abstract)

Citation Number 30

Bramble, W. C., and W. R. Byrnes. 1955. Effect of certain common brush control techniques and materials on game food and cover on a power line right-of-way, No. 1. Pennsylvania Agricultural Experiment Station, Progress Report 126. 4pp.

A replicated series of treatments have been set up on a 3-mile section of a powerline right-of-way designed to compare the effects of the spray application on game food and cover of an upland oak-hickory forest cover type. These treatments include a summer foliage spray with 2,4-D + 2,4,5-T, a foliage spray with Ammate, a summer basal spray with D + T in oil and in oil-water carriers, and a selective winter basal spray with 2,4,5-T. A uniform plant community has been described covering the right-of-way at the time of spraying. All sprays caused a foliage kill of from 80 to 100%, but stem kill vaired. The highest percent of stem kill was obtained from the summer and winter basal sprays with the highest number of seedlings and single sprouts being missed in the winter applications. (Authors' summary)

Citation Number 31

Bramble, W. C., and W. R. Byrnes. 1955. Effect of certain common brush control techniques and materials on game food and cover on a power line right-of-way, No. 2. Pennsylvania Agricultural Experiment Station, Progress Report 135. 7pp.

A replicated series consisting of 5 spray treatments and 1 control were applied to woody brush by commercial techniques on a power line right-of-way in central Pennsylvania in June 1953 and January 1954. Data were taken 2 growing seasons after the first applications. ... Wildlife usage of the sprayed areas after treatment has indicated that the right-of-way is still attractive to game species and that small game, in particular may be expected to increase as the plant cover develops. [Herbicides included 2,4-D, 2,4,5-T, and Ammate]. (Authors' summary)

Citation Number 32

Bramble, W. C., W. R. Byrnes, and D. P. Worley. 1956. Effects of certain common brush control techniques and materials on game food and cover on a power line right-of-way, No. 3. Pennsylvania Agricultural Experiment Station, Progress Report 151. 7pp.

[Results after 3 years of the study described by Bramble and Byrnes (1955) indicate that improved game food conditions have resulted from all treatments.] Highly valued shrubs such as blueberries and teaberries were present in large numbers only in the basal spray treatments. In the broadcast spray areas a grasslike or herbaceous community dominated, and while these are attractive to certain forms of wildlife, important shrubs were sparse or absent. Common game species of the region continued to use all treatment areas during the third year after spraying, indicating that these areas were making an important contribution towards the maintenance of the game population. (Authors' summary)

Citation Number 33

Bramble, W. C. W. R. Byrnes, and D. P. Worley. 1956. Effects of certain common brush control techniques and materials on game food and cover on a power line right-of-way, No. 4. Pennsylvania Agricultural Experiment Station, Progress Report 175. 4pp.

[Results after 4 years of the study described by Bramble and Byrnes (1955) indicate that] by use of basal sprays a stable ground cover can be maintained with minimum disturbance. Such cover has proven useful to several important game species. On the other hand, broadcast spraying resulted in drastic alterations of the low plant cover which has been slowly progressing towards a more stable condition. The broadcast spray areas are used by several important wildlife species. ... (Authors' summary)

Citation Number 34

Bramble, W. C., W. R. Byrnes, and R. J. Hutnik. 1958. Effects of chemical brush control upon game food and cover. Pennsylvania Agricultural Experiment Station, Progress Report 188. 7pp.

[Results after 5 years of the study described by Bramble and Byrnes (1955) indicate that] considerable disturbance of plant cover, both in amount and kind, followed broadcast and semi-basal techniques. Fireweed became prominent for several years after which the plant community developed toward its original composition. Blueberry which was practically eliminated by broadcast sprays remained sparse. The selective basal techniques maintained the original plant community as a low cover. ... The development of edges and type interspersion through cutting of the right-of-way and elimination of woody brush on it has favored such species as turkey and rabbits. Deer use the sprayed areas heavily in the spring and summer while grouse appear to prefer the wooded edges. (Authors' summary)

Citation Number 35

Bramble, W. C. 1962. Game food and cover produced during seven years of chemical brush control. Proceedings of the Southern Weed Control Conference 15:16-26.

Seven years of observations have been made on the effects of chemical sprays [2,4-D, 2,4,5-T, ammate] upon game habitat on a powerline right-of-way. ... The type of plant cover produced has differed markedly with the technique used. Broadcast sprays created considerable disturbance as compared with selective basals which maintained a tight cover. ... Broadcast sprays caused a marked secondary succession including creation of such temporary communities as a fireweed stage and elimination of important low woody plants such as blueberries and huckleberries. In all cases there has been a gradual development towards a stable shrub community of bracken, sedge, mixed herbs and woody shrubs. ... All sprays created cover type interspersion on the plateau and produced food and cover used by common game species present, which included deer, rabbits, grouse, turkey and grey squirrels. (Author's abstract)

Citation Number 36

Bramble, W. C., and W. R. Byrnes. 1967. Ecological aspects of brush control - A long term study on a utility right-of-way. Purdue Agricultural Experiment Station Research Bulletin 835. 12pp.

[The study described by Bramble and Byrnes (1955) was continued with a reapplication of treatments in 1966. Use patterns of the different treatment areas by deer, grouse, turkey, squirrel, and rabbits are described. This is the same paper as Bramble and Byrnes 1967.] (KVM abstract)

Citation Number 37

Bramble, W. C., and W. R. Byrnes. 1967. Ecological aspects of brush control - a long term study on a Pennsylvania right-of-way. Proceedings of the Northeast Weed Control Conference 21:406-412.

[The study described by Bramble and Byrnes (1955) was continued with a reapplication of treatments in 1966. Use patterns of the different treatment areas by deer, grouse, turkey, squirrel, and rabbits are described.] (KVM abstract)

Citation Number 38

Bramble, W. C. 1968. Do herbicides affect game? Pennsylvania Game News 39:26-29.

[The 13 year-old study initiated by Bramble and Byrnes (1955) is described and the effects of the various treatments on game species is discussed.] The study has clearly revealed that game has flourished and increased in the area, and even that species such as rabbits, which are not common in the forest, have moved in, increasing the species of game in a given plot under scrutiny. (KVM abstract)

Citation Number 39

Bramble, W. C., and W. R. Byrnes. 1969. Fifteen years of ecological research on a utility right-of-way. Proceedings of the Northeast Weed Control Conference 23:270-278.

[The study described by Bramble and Byrnes (1955, 1967a, b) was evaluated 15 years after the initial treatment with particular attention to deer forage availability and use. Herbaceous species such as bracken, goldenrod, loosestrife, and aster were eaten commonly and were sparse or lacking in the adjacent forest. Woody plants such as sweet-fern, sassafras, bear oak, and witch-hazel, were also commonly utilized.] (KVM abstract)

Citation Number 40

Bramble, W. C., and W. R. Byrnes. 1972. A long-term ecological study of game and cover on a sprayed utility right-of-way. Purdue University Agricultural Experiment Station, Research Bulletin 885. 20pp.

Herbicide treatments applied in 1953 were highly effective in controlling woody brush of mixed upland oak species on a utility right-of-way. ... A stable low plant cover ... persisted on unsprayed control areas throughout the 19-year study period. Species such as bracken, sedge, loosestrife, and blueberry were continuously present. ... In contrast, broadcast sprays [reduced] low plant cover to 10% during the first year after application and caused changes in floristic composition to fireweed and sedge-grass communities. ... A diversity of food plants useful to wildlife developed on the right-of-way following spraying. ... The right-of-way was heavily used by common wildlife species such as white-tailed deer, rabbit, grouse, and wild turkey. (Authors' summary)

Citation Number 41

Bramble, W. C. 1974. Songbirds on the right-ofway. Industrial Vegetation Management 6:12-14.

[The author provides a general description of the bird species diversity along the experimentally sprayed electric transmission right-of-way described by Bramble and Byrnes (1955, 1967a,b).] (KVM abstract)

Citation Number 42

Bramble, W. C., and W. R. Byrnes. 1976. Impact of brush control on wildlife food and cover. Pp. 136-135 *in* W. H. Byrnes and H. A. Holt, eds. Herbicides in Forestry. Proceedings of the J.S. Wright Forestry Conference. Purdue University, West Lafayette, Indiana.

[The study initiated by Bramble and Byrnes (1955) is described and the effects of the various treatments on game species is discussed. Evidently the right-of-way with its low dense plant cover has produced edges and type interspersion in contrast to the uncut forest with its sparse ground layer, and is providing an important improvement of the local habitat.] (KVM abstract)

Citation Number 43

Bramble, W. C., and W. R. Byrnes. 1979. Evaluation of the wildlife habitat values of rights-of-way. Journal of Wildlife Management 43:642-649.

Wildlife habitat on segments of a sprayed electric transmission right-of-way (ROW) was evaluated by a new technique [described by Flood et al. 1977, USF&W Serv. Res. Bull. 132] that provided useful quantitative habitat values based upon field rating of essential needs of selected species. Similar evaluation was made of the adjacent forest unmodified by a ROW. Use of the technique in central Pennsylvania with white-tailed deer (*Odocoileus virginianus*) gave an average value of 8.2 for segments of a sprayed ROW with a forest edge as compared with 5.5 for adjacent oak forests without a ROW. A realistic evaluation of the differences between the 2 habitat types appeared to be obtained. ... (Authors' abstract)

Citation Number 44
Bramble, W. C., and W. R. Byrnes. 1981. Effect of an electric transmission right-of-way on forest wildlife habitat. Pp. 57.1-57.11 *in* R. E. Tillman , ed. Proceedings of the Second Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

A new evaluation technique has been used to obtain quantitative values for important habitat factors that can be related to the needs of wildlife. A comparison has been made of wildlife habitat on replicated right-of-way treatment areas with the adjoining forest without a right-of-way. The average habitat value of the forest was 5.0. The right-of-way habitat traversing the forest averaged 7.6 for areas maintained by herbicide sprays, and 7.7 for areas maintained by cutting. (Authors' abstract)

Citation Number 45
Bramble, W. C., and W. R. Byrnes. 1982. Development of wildlife food and cover on an electric transmission right-of-way maintained by herbicides: a 30 year report. Purdue Agricultural Experiment Station Research Bulletin 974. 24pp.

A 30-year study of effects of herbicide sprays on wildlife food and cover has been carried out in central Pennsylvania on a 180-foot-wide electric transmission right-of-way to answer the question, "Do herbicides damage wildlife habitat?" The herbicides used were 2,4-D, 2,4,5-T and ammonium sulfamate. Highly acceptable control of tall-growing woody species was maintained, and excellent wildlife habitat conditions were developed by five different initial spray applications followed by selective herbicide spray maintenance. ... The common plant food species available on the right-of-way rated high in wildlife feed value. ... A typical proclimax vegetation type resulted that may be maintained by tree removal with herbicides. This proclimax is characterized by high species density and richness, and a consistent floristic composition. (Authors' summary)

Citation Number 46
Bramble, W. C., and W. R. Byrnes. 1983. Thirty years of research on development of plant cover on an electric transmission right-of-way. Journal of Arboriculture 9:67-74.

A study of vegetation development and production of wildlife food and cover has been made on an electric transmission right-of-way (ROW) in central Pennsylvania over a period of 30 years. Vegetation was maintained with herbicide sprays of 2,4-D, 2,4,5-T and ammonium sulfamate (AMS) compared with handcutting on separate areas assigned in a randomized block design over a 3-mile segment of ROW. A low plant cover resistant to tree invasion was developed which changed from dominant forest plants (bracken, vernal sedge, loosestrife, witch-hazel, and blueberry) to a relatively stable proclimax maintained by spraying and which was dominated by a combination of forest plants plus plants of openings (sweetfern, blackberry, dewberry, goldenrods, and hayscented fern). All of these dominant plants spread vegetatively by rhizomes or shallow roots to produce a mosaic pattern of irregular patches. Wildlife food and cover was increased on all areas and valuable shrubby edges developed. This produced a high wildlife habitat rating for the ROW as compared with the adjoining forest. (Authors' abstract)

Citation Number 47
Bramble, W. C., W. R. Byrnes, and M. D. Schuler. 1984. The bird population of a transmission right-of-way maintained by herbicides. Journal of Arboriculture 10:13-20.

A census was made of the bird population on an electric transmission right-of-way (ROW) and the adjoining forest in central Pennsylvania in July, 1982. The ROW had been maintained for 30 years by herbicide sprays with hand-cutting as a control. A large and diverse bird population of 31 species, which averaged 6.4 birds per hectare per census day had developed on the ROW. The common species were typical of shrublands and open areas. In the adjoining forest, an average of 3.4 birds per hectare were counted per

day; and the population contained 27 species. There was no significant difference at the 0.05 level between the number of birds on handcut- and herbicide-maintained ROW areas; the numbers of birds was significantly less in the forest than on the ROW. Immature birds made up 8% of the total ROW count. (Authors' abstract)

Citation Number 48

Bramble, W. C., W. R. Byrnes, and R. J. Hutnik. 1985. Effects of a special technique for right-of-way maintenance on deer habitat. Journal of Arboriculture 11:278-284.

White-tailed deer (*Odocoileus virginianus*) habitat and use were evaluated on an electric transmission right-of-way (ROW) before and after 5 different herbicide treatments and handcutting were applied using a special technique. ... Although appreciable changes occurred in specific deer habitat factors, decreases in certain factors were offset by increases in other factors. As a consequence, total habitat values remained high. Deer presence increased on all ROW treatment areas from 1982 to 1984. Deer browsed both woody and herbaceous vegetation comparably on the ROW and in the forest. The utilization factor, percent cover x percent browsed, was higher for woody vegetation in the forest and for herbaceous vegetation on the ROW. [Herbicides used were Garlon 4 (triclopyr), Weedone 2,4-DP (dichlorprop) + Amdon 101 (picloram + 2,4-D), Tordon K (picloram) and Tordon RTU (picloram + 2,4-D) (Authors' abstract)

Citation Number 49

Bramble, W. C., W. R. Byrnes, and M. D. Schuler. 1986. Effects of special right-of-way maintenance on an avian population. Journal of Arboriculture 12:219-226.

The effects of five right-of-way (ROW) maintenance techniques on birds was studied on an electric transmission line right-of-way in central Pennsylvania. The techniques included handcutting and four different herbicide applications. An important feature of these techniques was a differential treatment of wire and border zones of the ROW. Bird censuses made before and after treatment indicated that the total number of birds of the six most common species were not significantly affected by any of the six treatments. Although a decrease occurred in the average number of species counted, species diversity after treatment was not significantly different between treatments. Important changes occurred in the relative number of individuals per species and, as a result, in species dominance, after both handcutting and herbicide treatments. (Authors' abstract)

Citation Number 50

Bramble, W. C., W. R. Byrnes, and R. J. Hutnik. 1987. Development of plant cover diversity on an electric transmission right-of-way. Pp. 89-93 *in* W. R. Byrnes and H. A. Holt, eds. Proceedings of the Fourth National Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

Effects of a special right-of-way (ROW) maintenance technique on plant cover diversity was studied on an electric transmission ROW in central Pennsylvania. The important feature of this technique was a differential treatment of wire and border zones. The wire zone included the ROW area lying under the wires and the two border zones occupied the remaining ROW area on both sides. Four herbicide treatments and handcutting were applied in five replications. All trees and tall shrubs were treated in the wire zone; while trees only were treated in border zones. Pellet applications of Tordon 10K and stem-foliage sprays of Weedone 2,4-DP with Tordon 101 produced a low cover of grass-herb-fern in the wire zone and a tall shrub-low shrub-grass-herb on the borders. Summer basal of Garlon 4 and frill and squirt of Tordon RTU applications were less drastic and produced a medium shrub-herb-grass cover dominated by blackberry in the wire zone. Handcutting produced a sapling tree thicket. The borders remained practically unchanged. Deer use of the ROW remained high after treatments and a diverse deer habitat developed. The songbird population of the ROW and the dominant bird species were retained. (Authors' abstract)

Citation Number 51

Braun, C. E., T. Britt, and R. O. Wallestad. 1977. Guidelines for maintenance of sage grouse habitats. Wildlife Society Bulletin 5:99-106.

The importance of sagebrush (*Artemisia* spp.) to maintenance of population stability of sage grouse (*Centrocercus urophasianus*) is documented from reviews of studies throughout the range of this species. Known effects of sagebrush control [including use of herbicides] on sage grouse are presented. Guidelines for the maintenance of sage grouse habitats promulgated by the Western Association of State Game and Fish Commissioners are given. (Author's abstract)

Citation Number 52

Brooks, J. J. 1992. Chemical site preparation: effects on wildlife habitat and small mammal populations in the Georgia Sandhills. M.S. Thesis, University of Georgia, Athens. 90pp.

A chemical site preparation study was established in Marion County, Georgia in the Sandhills physiographic province. Three chemical site preparation treatments were applied, and resulting changes in vegetation and small mammal communities were compared. Woody stem densities were compared by species and diameter class from pre-treatment to 1 year post-treatment. Frequency of occurrence was used to assess treatment differences in the herbaceous plant community. Significant differences occurred among treatments for both woody and herbaceous species. Similarly, the abundance of wildlife food plants and plant species diversity varied among treatments. There was an initial decline in small mammal abundance following treatment, however, at 18-months post-treatment, most species were higher in abundance than at any previous trapping period. Small mammal capture rates indicate species-specific correlations with the abundance of various vegetational groups. Different types of chemical site preparation can selectively alter habitat conditions for wildlife species that use early seral stages. (Author's abstract)

Citation Number 53

Brooks, J. J., A. S. Johnson, and K. V. Miller. 1993. Effects of chemical site preparation on wildlife habitat and plant species diversity in the Georgia Sandhills. Pp. 605-612 *in* J. C. Brissette, ed. Proceedings of the Seventh Biennial Southern Silvicultural Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SO-93.

[The authors] compared plant species diversity and abundance of food plants of bobwhite quail (*Colinus virginianus*), white-tailed deer (*Odocoileus virginianus*), and gopher tortoises (*Gopherus polyphemus*) among hexazinone, picloram + triclopyr, and imazapyr treated sites at 1 year post treatment. Hexazinone-treated areas produced more quail and deer food plants than the other 2 treatments. The abundance of gopher tortoise foods was similar among treatments although there were major differences in the plant species comprising these foods. Herbaceous plant species diversity was highest on the imazapyr treatment and lowest on the hexazinone treatment, whereas woody species diversity was lowest on the hexazinone treatment and highest on the picloram + triclopyr treatment. Different herbicide site preparation treatments can result in considerable variation in wildlife habitat quality and plant species diversity. (Authors' abstract)

Citation Number 54

Brooks, J. J., J. L. Rodrigue, M. A. Cone, K. V. Miller, B. R. Chapman, and A. S. Johnson. 1995. Small mammal and avian communities on chemically-prepared sites in the Georgia Sandhills. Pp. 21-23 *in* M.B. Edwards, compiler. Proceedings of the Eighth Biennial Southern Silvicultural Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SRS-1.

The effect of 3 forestry herbicide site preparation treatments (hexazinone, picloram + triclopyr, and imazapyr) on small mammal and avian communities were compared at 0, 1, 2, and 3 years post-treatment.

Few differences in small mammal capture rates occurred among treatments. Capture rates declined immediately following site preparation, but returned to pre-treatment levels by 18 months post-treatment. Songbird abundance was correlated with the density of residual woody stems. The greatest winter avian abundance occurred at 3 years post-treatment; however, no differences in winter avian abundance were observed among treatments. In year 3 post-treatment, summer birds favoring forest edge + scrub habitats were higher on hexazinone-treated sites. (Authors' abstract)

Citation Number 55

Brown, E. R. 1967. Impact of range improvement practices on wildlife habitat. Pp. 243-247 *in* M.A. Newton, ed. Herbicides and vegetation management in forest, ranges, and noncrop lands. School of Forestry, Oregon State University, Corvallis.

Although herbicides have little direct effect on wildlife species, the ecological changes that they create in wildlife habitat have a very pronounced effect. [The effects of range vegetation management by herbicides on elk, deer, sage grouse, and antelope are reviewed.] (KVM abstract)

Citation Number 56

Bull, E. L., and A. D. Partridge. 1986. Methods of killing trees for use by cavity nesters. Wildlife Society Bulletin 14:142-146.

[Six methods of creating snags and the use of these snags by cavity nesting birds were evaluated on the Starkey Experimental Forest, Union Co., Oregon. Methods included topping with a chainsaw, herbicide (MSMA), topping by dynamite, girdling, fungal inoculation, and pheromone application. Trees topped with a chainsaw provided the best potential nest sites. Although herbicide killed the trees, the trees frequently fell and were seldom used for foraging or nesting.]

Citation Number 57

Buttery, R. F., and P. W. Shields. 1975. Range managment practices and bird habitat values. Pages 183-189 *in* D. Smith, ed. Proceedings of the Symposium, Management of Forest Habitat for Nongame Birds. United States Department of Agriculture, Forest Service, General Technical Report WO-1.

This paper aggregates available information on the known and probable effects of fourteen range management practices upon nongame bird habitat. Five research goals are suggested to secure the additional information necessary to predict these effects, to determine bird habitat requirements, and to present findings in a manner usable in the formulation of range management plans. [Herbicide treatment is one of the range management practices discussed.] (Authors' abstract)

Citation Number 58

Campbell, D. L., J. Evans, G. D. Lindsey, and W. E. Dusenberry. 1981. Acceptance by black-tailed deer of foilage treated with herbicides. United States Department of Agriculture, Forest Service, Research Paper PNW-290. 31pp.

To test their acceptance of foilage treated with herbicides, captive black-tailed deer were exposed to Douglas-fir seedlings and salal treated with standard formulations of 2,4,5-T, 2,4-D, atrazine, dalapon, fosamine, and glyphosate herbicides [from November 1977 through February 1978]. ... Deer readily browsed 2,4,5-T treatments and most formulations of 2,4-D in oil compared with oil alone, but showed rejection of some phytotoxic glyphosate treatments. Consumption of herbicide-treated foilage did not cause noticeable health problems in test animals. (Authors' abstract)

Citation Number 59
Campo, J. J., and G. A. Hurst. 1980. Soft mast production in young pine plantations. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 34:470-475.

[Soft mast production was measured on loblolly pine plantations, ages 1 to 9 years, in Mississippi. Treatment effects analyzed were plantation age, site preparation method, fertilization, and herbicide application. Tree-crushed and burned plantations were sprayed with 2,4,5-T @ 0.91 kg/ha in May. Spraying at the peak of blackberry production, age 4 or 5, probably decreased mast production the year of spraying because blackberry plants and other potential mast producers decreased in abundance after herbicide application. Two years after spraying, at age 6 and 7, mast production was so low that there was no difference between sprayed and unsprayed.] (KVM abstract)

Citation Number 60
Carlson, R. A. 1974. The noxious weed problems on state wildlife lands. Proceedings of the North Central Weed Control Conference 29:108-109.

[Minnesota] finds itself on the one hand planting grasses and legumes for wildlife nesting and then spraying these same fields for noxious weeds with the resultant loss of legumes and broadleaf plants. The environmental concern on the use of herbicides and the potential loss of wildlife habitat through continued application poses a ... problem and concern. (KVM abstract)

Citation Number 61
Carpenter, L. H. 1972. A literature review on the role of mineral fertilizers in big game range improvement. Part 1: Effects of nitrogen fertilizer and 2,4-D herbicide on range forage production and use. Colorado Division Game, Fish, and Parks, Special Report 28. 9pp.

Literature on the effects of nitrogen fertilizer and 2,4-D herbicide on native rangelands is reviewed. Particular attention is given to findings where there are demonstrated or inferential significance to wildlife, especially big game. The effects on plant growth, vegetative composition, chemical content of plants, and palatability of plants to grazing animals induced by the fertilizer and herbicides used, separately or in combination, reveal possibilities for their beneficial application to game ranges. (Author's abstract)

Citation Number 62
Carpenter, L. H. 1976. Nitrogen-herbicide effects on sagebrush deer range. Ph.D. Dissertation, Colorado State University, Fort Collins. 174pp.

Three areas located on big sagebrush range in Middle Park, Colorado were studied to evaluate the effect of ammonium nitrate fertilizer applied with and without 2,4-D herbicide on herbage yields and botanical composition. Nitrogen was applied at five levels: 0, 33.6, 67.2, 100.8, 134.4 kg/ha ... and 2,4-D herbicide at two levels: 0, 2.2 kg/ha. .... Measurements of grazing use by tame, trained deer were made each winter on the various treatments. ... The herbicide reduced shrub herbage, total herbage, and forb yields in all years. Grass yields increased in all years on the herbicide treated plots. ... The deer did not show a significant preference for plants in any one individual treatment. Contrary to general belief, grasses consistently made up over 60 percent of deer diets during winter grazing trials. (Author's abstract)

Citation Number 63
Carr, H. D., and F. A. Glover. 1970. Effects of sagebrush control on sage grouse. Transactions of the North American Wildlife and Natural Resources Conference 35:205-215.

... By 1.5 years after spraying [an area in northcentral Colorado with 2,4-D], sagebrush control had not obviously affected strutting activities or grounds. Neither had it definitely affected nesting density or success; however, nests on sprayed areas tended to be near unsprayed areas. The effects of sagebrush control

on nesting may become more evident as dead sagebrush deteriorates. Brood production and survival had not noticeably been affected. Sprayed sagebrush affected but did not hamper movements of adult sage grouse; however, they avoided block-sprayed areas (except for strutting), probably because necessary habitat requirements were lacking. Areas sprayed in 50-yard wide strips had no obvious effects on distribution or movements of adult sage grouse. ... (Authors' summary)

Citation Number 64
Carter, M. C., J. W. Martin, J. E. Kennamer, and M. K. Causey. 1975. Impact of chemical and mechanical site preparation on wildlife habitat. Down-To-Earth 31:14-18.

Chemical site preparation does not completely eliminate all vegetation. ... Frequently, the abundance and diversity of the vegetation on the chemically prepared sites is greater than that which occurred prior to timber harvest or results from mechanical site preparation. ... On chemically prepared areas, many of the woody mast producers escape injury, recover or resprout. If regeneration areas are well interspersed with mature stands, and if stand rotation length is sufficient to allow resprouts to reach mast-bearing age, the long term effects of chemical site preparation should not be detrimental. (KVM abstract)

Citation Number 65
Carter, M. C., J. W. Martin, J. E. Kennamer, and M. K. Causey. 1975. Impact of chemical and mechanical site preparation on wildlife habitat. Pp. 323-333 *in* B. Bernier and C. H. Winget, eds. Forest soils and forest land management. Laval University Press, Quebec, Canada.

(see Carter et al. 1975)

Citation Number 66
Carvell, K. L. 1975. Environmental impacts of herbicides on electric transmission line rights-of-way. Journal of Arboriculture 1:129-130.

[Reports on a study of the environmental impact of frequent herbicide application to electric transmission line rights-of-way in nine states. Comparison of] unsprayed old fields with the communities present on the line study areas showed that line area communities are comparable, or often superior, to the old fields for wildlife. (KVM abstract)

Citation Number 67
Cavanagh, J. B., D. P. Olson, and S. N. Macrigeanis. 1976. Wildlife use and management of power line rights-of-way in New Hampshire. Pp. 275-285 *in* R. Tillman, ed. Proceedings of the First National Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

[Wildlife abundance on a newly clearcut area of a right-of-way in New Hampshire was significantly lower than that on a selectively cut area but significantly greater than that on an old clearcut area which had been maintained with foliage sprays of 2,4-D and 2,4,5-T.] (KVM abstract)

Citation Number 68
Chamberlain, E. B. and T. K. Goodrich. 1962. Aerial and mist-blower application of herbicides in southern forests as related to wildlife management. Transactions of the North American Wildlife and Natural Resources Conference 27:384-393.

[In addition to other conclusions, the Herbicide Sub-Committee, Southeastern Section of The Wildlife Society reported that] it appears that widespread application of herbicides on upland, pine-hardwood sites may benefit deer and rabbit, harm squirrel, turkey, and coon, and temporarily benefit

grouse. As the age of the pine stand increases, conditions for deer and rabbit will also probably worsen. [Recommendations for minimizing impacts on wildlife are presented and prime research needs are outlined.] (KVM abstract)

Citation Number 69
Chamberlain, E. B., Jr. 1969. Effects of hardwood control on food and cover. Pp. 77-80 *in* L. K. Halls, ed. White-tailed Deer in the Southern Forest Habitat. Southern Forest Experiment Station, Nacodoches, Texas.

The importance of hardwoods in providing food and cover for white-tailed deer in the southern forest habitat is documented by pertinent literature. Hardwood control is, therefore, a matter of much concern in deer management. The most common types are burning, chemical, and mechanical. In one or another form, the practice is well established. There are direct relationships between hardwood controls (and timber management practices generally) and production of deer foods. Effects depend upon intensity of treatment and on size and distribution of treatment blocks. (Author's abstract)

Citation Number 70
Chasko, G. G., and J. E. Gates. 1979. Avian breeding success in relation to grassland and shrubland habitats within a 138 kV Transmission-line corridor. Pp. 68.1-68.12 *in* R.E. Tillman , ed. Proceedings of the Second Symposium, Environmental Concerns in Rights-of-Way Management, Mississippi State University.

During the nesting season of 1978, avian breeding success was evaluated at two 18.4-ha sites along a 138 kV transmission-line corridor in Allegany County, Maryland. [Two study sites were selected: a grassland mowed annually in late summer and a shrubland site maintained by periodic selective herbicide spraying.] Breeding success was highest in the shrubland portion of the corridor. Bird use of the grassland area was minimal and limited to two mixed-habitat species. Characteristic grassland birds were absent from this corridor habitat type. Although overall breeding success at the grassland site was lower than at the shrubland site, individuals of certain avian species nesting in smaller patches of shrubs at this site had much higher success rates. (Authors' abstract)

Citation Number 71
Chasko, G. G., and J. E. Gates. 1982. Avian habitat suitability along a transmission-line corridor in an oak-hickory forest region. Wildlife Monographs 82:1-41.

A study of open-nesting passerines was made at 2 sites along a 138-kv transmission-line corridor through a forested region of Allegany County, Maryland, during 1978 and 1979. [Two study sites were selected: a grassland mowed annually in late summer and a shrubland site maintained by periodic selective herbicide spraying.] Patterns of fledging success and spatial distribution of nests were assessed in each habitat type in relation to the corridor, corridor-forest edge, and the adjacent forest habitat. Important features of the nest microhabitat that may influence nest success were evaluated for both corridor and forest nesting birds. ... (Authors' abstract)

Citation Number 72
Chen, M. Y. 1974. Effects of herbicides and repeated burns on the understory vegetation of loblolly-shortleaf pine forests on hilly terrains. Ph. D. Dissertation, Auburn University. 143pp.

Herbicides [2,4,5-T, 2,4-D, and picloram] and repeated burns were tested in 40-year-old stands of loblolly-shortleaf pine (*Pinus taeda* and *P. echinata*) on hilly terrain at Camden, Alabama. ... Over a ten-year period, understory composition and wildlife habitat were drastically changed. The hardwood canopy of trees over six feet in height was greatly reduced by burning and double spraying treatments. ... Herbicide

treatments only slightly increased the yield of game food. Repeated winter burning was considered the best of the treatments applied from the standpoint of a combined wood-wildlife production goal. (Author's abstract)

Citation Number 73
Christensen, M. D., J. A. Young, and R. A. Evans. 1974. Control of annual grasses and revegetation in the ponderosa pine woodlands. Journal of Range Management 27:143-145.

Application of 1.12 kg/ha of the herbicide atrazine sufficiently controlled medusahead or downy brome to permit establishment of perennial wheatgrass in ponderosa pine woodlands previously burned by wildfires. ... Bitterbrush seedlings established naturally in areas treated with atrazine. Apparently the herbicide treatment created a desirable habitat for seed caching by rodents, along with reduction of competition from annual grasses. ... (Authors' abstract)

Citation Number 74
Clough, G. C. 1987. Relations of small mammals to forest management in northern Maine. Canadian Field-Naturalist 101:40-48.

The effects of forest management practices on small mammals were investigated across northern Maine in the summer of 1982. Fourteen different forest types, grouped as early successional stages, mature conifer, and mature mixed or hardwood, were studied. Ten species of mammals were collected. Relative abundance, species richness, diversity, and evenness for each habitat and niche breadth for individual species were calculated. ... Clearcut sites sprayed with herbicide [2,4,5-T] or burned one to four years previously had low abundance but retained moderate diversity and richness. ... (Authors' abstract)

Citation Number 75
Colbert, R. L., R. D. Petit, and E. F. Cheslk. 1985. Small mammal response to converting a sand shinnery oak ecosystem to a midgrass prairie. Research Highlights Noxious Brush and Weed Control, Range and Wildlife Management, Texas Tech University, Lubbock 16:4.

[The study assesses the differences in small mammal composition and abundance following application of Graslan for sand shinnery oak control, resulting in conversion to a midgrass prairie ecosystem. Initial results indicate small mammal species compostion and abundance are similar in two treated and two control sites; however, populations are larger in treated areas.] (DLH abstract)

Citation Number 76
Cole, E. C., W. C. McComb, M. Newton, C. L. Chambers, and J. P. Leeming. 1995. Response of small mammal and amphibian capture rates to clearcutting, burning, and glyphosate application in the Oregon coast range. Pp. 155-157 *in* R. E. Gaskin and J. A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

Small mammal and amphibian capture rates were monitored on three replicate sites scheduled for hardwood conversion for one year prior to clearcutting and two years post-clearcutting. Of the 6 small mammal species analyzed, deer mice (*Peromyscus maniculatus*) were unaffected, creeping vole (*Microtus oregoni*) and vagrant shrew (*Sorex vagrans*) initial capture rates increased in upland areas, Townsend's chipmunk (*Tamias townsendii*) capture rates increased in buffered areas of logged units, and Pacific shrews (*S. pacificus*) and Trowbridge's shrews (*S. trowbridgii*) decreased in upland areas after clearcutting and burning. Capture rates of ensatina salamanders (*Ensatina eschscholtzi*) and Pacific giant salamanders (*Plethodon dunni*), rough-skin newts (*Taricha granulosa*), and red-legged frogs (*Rana aurora*) were not

detectable. Western redbacked salamander (*P. vehiculum*) capture rates increased in upland areas the first year after logging, but decreased to pretreatment levels the second year after logging. For all species, changes in capture rates on areas sprayed with glyphosate did not differ from rates on clearcut, unsprayed areas. (Authors' summary)

Citation Number 77

Cone, M. A., J. J. Brooks, B. R. Chapman, and K. V. Miller. 1993. Effects of chemical site preparation on songbird use of clearcuts in Georgia. Proceedings of the Southern Weed Science Society 46:175.

A chemical site preparation study was established in 1990 in Marion County, Georgia to evaluate vegetation and wildlife habitat conditions pre- and post-treatment. In 1991-92, winter and breeding bird censuses were initiated to analyze songbird use of the chemically treated clearcuts. Three herbicide treatments were used in site preparation: (1) Arsenal (imazapyr), (2) Pronone 10G (hexazinone), (3) Tordon 101 (picloram + 2,4-D) + Garlon 4 (triclopyr). Vegetative composition, abundance, and diversity were estimated prior to herbicide application and at one year post-treatment. ... Arsenal was the most effective herbicide in reducing woody stems. The Tordon 101 + Garlon 4 treatment had the highest occurrence of grasses, while Arsenal produced the greatest number of legumes. Bird species abundance and diversity were estimated for the first year of censusing. The Pronone 10G treatment had a significantly larger number of wintering birds than the other two treatments. There was no significant difference among treatments for species diversity or breeding bird abundance. (Authors' abstract)

Citation Number 78

Cone, M. A. 1995. Effects of chemical site preparation treatments on avian abundance and diversity. M.S. Thesis, University of Georgia, Athens. 52pp.

[Winter and breeding bird populations in the Sandhills region of the Upper Coastal Plain, Georgia were surveyed at 2 and 3 years post-treatment on clearcut areas site-prepared with hexazinone, picloram + triclopyr, or imazapyr . Mean winter bird numbers were not different among the treatments. Mean abundance of summer birds characteristic of forest interior and edge habitats was higher on the imazapyr-treated site compared to the hexazinone-treated site. In year 3 post-treatment, mean density of summer birds favoring the forest edge and scrub was higher on the site prepared with hexazinone compared to the area treated with picloram + triclopyr. Summer bird numbers were strongly associated with residual woody vegetation. Bird species diversity varied seasonally but was similar among treatments.] (DLH abstract)

Citation Number 79

Conner, R. N., J. C. Kroll, and D. L. Kulhavy. 1983. The potential of girdled and 2,4-D injected southern red oaks as woodpecker nesting and foraging sites. Southern Journal of Applied Forestry 7:125-128.

Comparisons of extent of decay in southern red oaks (*Quercus falcata* Michx.) revealed that trees injected with 2,4-D decayed sooner than girdled trees. Internal examinations of treated trees revealed that girdling and injection permitted growth of heartwood- and sapwood-decaying fungi, a condition necessary for woodpecker nest cavity excavation. As a result of the delayed decay, girdling produces better woodpecker habitat in southern red oak. Girdled southern red oaks remain standing longer for woodpeckers to use as foraging and nesting sites. Number of snags required to support various percentages of woodpecker population maximums are presented. (Authors' abstract)

Citation Number 80

Conner, R. N. 1989. Injection of 2,4-D to remove hardwood midstory within red-cockaded woodpecker colony areas. United States Department of Agriculture, Forest Service, Research Paper SO-251. 4pp.

Red-cockaded woodpecker (*Picoides borealis*) colonies on the Angelina National Forest were monitored from 1984 to 1986, after hardwoods on the site had been injected with the herbicide 2,4-D. The herbicide effectively reduced the hardwood midstory; however, possible toxicity to woodpeckers and cavity tree mortality are problems associated with the use of 2,4-D. Because of its lower toxicity to pines, the herbicide hexazinone is suggested as an alternative to 2,4-D. Use of any herbicide is suggested only as a one-time application to eliminate large hardwoods so that prescribed fire can later be used to control hardwoods in woodpecker colonies. (Author's summary)

Citation Number 81

Connor, J., and L. Mcmillan. 1988. Winter utilization by moose of glyphosate treated cutovers - an interim report. Alces 24:133-142.

... This study was undertaken to determine if the use of ... [glyphosate] herbicide for controlling competing shrubs in plantations is significantly reducing forage resources and subsequent overwinter utilization by moose (*Alces alces*). Observations were carried out on 4 treated and control paired cutovers near Thunder Bay, Ontario. The numbers of overwinter moose tracks were not significantly different ($P > 0.05$) at 7 and 19 months post spray, but they indicated a preference for the non-treated control areas ($P < 0.05$) at 31 months post-spray. The number of moose track aggregates were similar in control and glyphosate-treated cutovers ($P > 0.05$), 7 months post-spray, but were more numerous ($P < 0.05$) on control portions, 19 and 31 months after treatment. Total track aggregate area and average track aggregate size were similar ($P > 0.05$) in all time periods, post-treatment. Available moose browse on control plots was four times greater, and utilized browse was 12 times greater, than on treated areas at 21 months post-spray. Estimated winter moose presence, calculated from pellet counts, was three times greater on untreated than treated areas after 21 months ($P < 0.05$). (Authors' abstract)

Citation Number 82

Connor, J. F., and L. M. Mcmillan. 1990. Winter utilization by moose of glyphosate-treated cutovers. Alces 26:91-103.

[The authors conclude the study as reported in Connor and McMillan (1988) including results up to 3 years post-treatment]. ... Moose presence and feeding activity throughout winter, as measured by ... aerial track counts, indicated that the numbers of overwinter moose tracks were not significantly different ($P > 0.05$) after 0 and 1 growing seasons post-spray, but they indicated a preference for the non-sprayed control areas ($P < 0.05$) at 2 and 3 growing seasons post-spray. The numbers of moose track aggregates were similar in all control and treatment cutovers ($P > 0.05$), prior to the first growing season post-spray, but were more numerous ($P < 0.05$) on control portions, 1, 2, and 3 growing seasons after treatment. Available moose browse, on control areas, was four times greater, and browse utilized was 32 times greater, than that in treated areas ($P < 0.05$) after 1 growing season post-spray. Estimated winter moose presence, calculated from pellet counts, was almost two times greater on untreated than treated areas after 1 growing season ($P < 0.05$) and similar at 2 growing seasons post-spray. ... Further research is recommended to determine the long-term impact of glyphosate application on wildlife habitat.

(Authors' abstract)

Citation Number 83
Connor, R. N., J. G. Dickson, and B. A. Locke. 1981. Herbicide-killed trees infected by fungi: potential cavity sites for woodpeckers. Wildlife Society Bulletin 9:308-310.

[The hardwoods in a 130-ha mixed loblolly-shortleaf, pine/hardwood forest in Houston Co., Texas were injected with 2,4-D and then aerially mist blown with 2,4,5-T. Two years later the 4 species of hardwoods examined had fruiting bodies of 10 species of fungi present. The authors conclude that injection of 2,4-D into selected hardwoods could be beneficial to cavity nesters by providing potential nesting and foraging sites. Injecting 10-20% of undesirable trees every 3-4 years could provide a sustained supply of snags.] (KVM abstract)

Citation Number 84
Copeland, J. D., and G. A. Hurst. 1984. Deer forage in loblolly pine plantations during the first year following intensive site preparation. Annual Meeting of the Southeast Deer Study Group, Little Rock, Arkansas 7:11.

Use of chemicals (herbicides) in intensive pine plantation management is increasing throughout the Southeast. Three loblolly pine (*Pinus taeda*) plantations [... in Mississippi ...] were sampled for preferred white-tailed deer (*Odocoileus virginianus*) forage in September 1982 and March 1983. The plantations were mechanically prepared (sheared, raked into windrows and burned, disced, and bedded) in the fall of 1981, planted in February 1982, and aerially sprayed with 4.68 or 7.01 l/ha of Velpar (hexazinone) in April 1982. Forage averaged 101 kg/ha in September 1982 and 4.3 kg/ha in March 1983. Total forage varied from 44 to 149 kg/ha in September and 2 to 8.4 kg/ha in March on the 3 plantations. Forbs accounted for 53% ... in September and 11% ... in March; vines 32% ... in September and 55% ... in March; grasses 3.4% ... in September and 18% ... in March; and woody browse, including stems and attached leaves, accounted for 11% ... in September and 16% in March. (Authors' abstract)

Citation Number 85
Copeland, J. D. 1986. Wildlife habitat conditions on loblolly pine plantations site prepared by mechanical and chemical methods. M.S. Thesis, Mississippi State University, Mississippi State. 48pp.

Three loblolly pine (*Pinus taeda*) plantations ranging in size from 54-160 ha near Longview, Oktibbeha County, Mississippi, were sampled for selected white-tailed deer (*Odocoileus virginianus*) forage, plant species composition, and loblolly pine growth at plantation ages 1 and 2 years. Mature pine-hardwood forests were clearcut and the 3 tracts were site prepared ... in the fall 1981, planted in February 1982, and aerially sprayed with 4.68 or 7.01 l/ha of Velpar (hexazinone) in April 1982. ... Total deer forage averaged 101 kg/ha in September 1982, 8.5 kg/ha in March 1983, 1135.5 kg/ha in September 1983, and 68.8 kg/ha in March 1984. ... There were 73 species of plants recorded in September 1982 and 164 species recorded in September 1983. ... (Author's abstract)

Citation Number 86
Copeland, J. D., and G. A. Hurst. 1986. Deer forage on pine plantations after intensive mechanical and chemical site preparation. Proceedings of the Annual Southern Weed Science Society 39:237.

[Three loblolly pine plantations in Oktibbeha Co., Mississippi, were sampled for preferred white-tailed deer forage at plantation ages 1 and 2. Plantations were sprayed with 0.5 or 0.75 lb/ac Velpar (hexazinone) in April of the first growing season. Deer forage by plant category (grass, forb, vine, woody) was estimated in Sept. 1982 and 1983 and in March 1983 and 1984. Total deer forage averaged 90 lb/ac in Sept. 1982 and 1,014 lb/ac in Sept. 1983. Total deer forage in March 1983 was 4 lb/ac but increased to 61 lb/ac in March 1984.] (KVM abstract)

Citation Number 87
Coulter, L. L. 1957. The role of herbicides in wildlife production through creation and stabilization of habitats. Down-To-Earth 13:4-6.

[Herbicides are now available which can be a real aid in producing more game on less land and in stabilizing vegetation types suitable for wildlife. The roles of herbicides in habitat management include: creating and maintaining openings in wooded areas, browse production, improvement of waterfowl habitat, chemical seedbed preparation for game food patches and other uses.] (KVM abstract)

Citation Number 88
Cran, H. J., Jr. 1969. Preservation of desirable species through selective use of herbicides. Proceedings of the Northeast Weed Control Conference 23:294-297.

[The Connecticut Shade Tree Council was established to prepare recommendations for the use of herbicides in controlling undesirable vegetation. These recommendations were approved in 1960 and The Connecticut Light and Power Company applied them to its roadside brush control specifications. Techniques for selectively using herbicides to maintain desirable low-growing woody plants and herbs that provide food and cover for wildlife are provided.] (KVM abstract)

Citation Number 89
Crawford, H. S. 1960. Effect of aerial 2,4,5-T sprays on forage production in west-central Arkansas. Journal of Range Management 13:44.

In May 1957, several hardwood tracts in the Ozark Mountains near Paris, Arkansas, were aerially sprayed with 2,4,5-T in order to convert them to range. [Description of vegetative responses are provided. The sprayed areas produced more browse plants of the species preferred by deer, such as blueberry and grape, than the unsprayed areas.] (KVM abstract)

Citation Number 90
Cross, D. H. 1983. Wildlife habitat improvement by control of *Phragmites communis* with fire and herbicide. M.S. Thesis, Colorada State University, Fort Collins. 81pp.

Phragmites communis, common reed, is an aggressive perennial grass typical of marshes. It has little food value for waterfowl and, when occurring in dense stands as climax vegetation, is rarely used by nesting waterfowl. ... The value of fire in marsh habitat improvement, as it affects phragmites, is limited to short-term, annual efforts in early spring to open up dense stands for nesting waterfowl. Dalapon is an effective chemical control when used on phragmites shoots emerging after burning. Burns in July and August, with herbicide spraying at least 48 days later, can most significantly reduce phragmites vigor as measured by height and density of stems. (Author's abstract)

Citation Number 91
Crouch, G. L. 1979. Atrazine improves survival and growth of ponderosa pine threatened by vegetative competition and pocket gophers. Forest Science 25:99-111.

Atrazine was applied to 0.1-acre (0.04-ha) plots of planted ponderosa pine (*Pinus ponderosa*) in south-central Oregon to alleviate competition from herbage and remove food supply of pocket gophers (*Thomomys mazama* Merriam) that prey on the trees. ... Fall treatments reduced abundance of gopher mounds eightfold compared with no treatment or application of atrazine in spring. Moreover, few mounds were counted during the years when herbicide effects were greatest. Gophers were responsible for most of the pine mortality, but losses were considerably lower on plots treated in the fall. ... Treatments may be even more effective on larger tracts where gophers do not have ready assess to untreated areas. (Author's abstract)

Citation Number 92
Cumming, H. G. 1989. First year effects on moose browse from two silvicultural applications of glyphosate in Ontario. Alces 25:118-132.

Aerial application of glyphosate at 1.07 kg/ha on a conifer plantation released planted trees satisfactorily while reducing moose browse stems available to moose (*Alces alces*) by only 5-41%. Loss of biomass for 8 major browse species (90% of stems browsed) amounted to 96 kg/ha. Browsed stems/ha decreased from 15-82% on 5 of 6 sprayed strata, and increased by 130-3200% in 5 of 6 control strata, but variability rendered differences insignificant. On a second study area, ground application of glyphosate at 2.7 kg/ha as pre-planting site preparation reduced available browse by 63-92%, resulting in a loss of 145 kg/ha (for 90% of the browsed stems). Apparantly, some silvicultural objectives can be achieved while retaining substantial densitites of browse plants for at least the first year, but other silvicultural applications may reduce browse availability mor seriously. (Author's abstract)

Citation Number 93
Cummings, M. W. 1962. Control of pocket gophers. Proceedings of the Vertebrate Pest Control Conference 113-125.

[In addition to other methods, the use of herbicides to remove gophers is discussed. On large areas of rangeland where weedy plants were the dominant vegetation, weed control with herbicidal spray resulted in removal of up to 90% of the gopher populations due to removal of their food supply.] (KVM abstract)

Citation Number 94
D'Anieri, P., M. L. McCormack, Jr., D. M. Leslie, Jr., and S. M. Zedaker. 1986. The small mammal community in a glyphosate conifer release treatment in Maine. Proceedings of the Northeastern Weed Science Society 40:205-209.

Small mammals were trapped in a 1-year-old glyphosate release treatment, a current-year glyphosate release treatment, and an unsprayed control treatment in a 4- to 5-year-old spruce-fir clearcut in Maine. The herbicide release did not affect the total number of small mammals on this site, but it did decrease the abundance of one species, the boreal redback vole. Creation of a more open habitat by glyphosate may not have been favorable for redback voles, but did not seem to affect numbers of masked shrews, deer mice, and pygmy shrews within one year after treatment. (Authors' abstract)

Citation Number 95
D'Anieri, P., D. M. Leslie, Jr., and M. L. McCormack, Jr. 1987. Small mammals in glyphosate-treated clearcuts in northern Maine. Canadian Field-Naturalist 101:547-550.

Effects of glyphosate [N-(phosphonomethyl) glycine] on small mammals in four- to five-year-old clearcuts were evaluated by snap- and pit-trapping one area one year after treatment, one area two months before and after, and one untreated control. All areas were sampled simultaneously in four trapping periods from July to October, 1984. Seven species were captured, but Masked Shrews (*Sorex cinereus*), Deer Mice (*Peromyscus maniculatus*), Southern Red-backed Voles (*Clethrionomys gapperi*), and Pygmy Shrews (*Microsorex hoyi*) comprised 97% of 290 captures. Only Southern Red-backed Voles were affected by glyphosate application, being significantly more abundant on the control and less numerous on the nine-year-old spray area. No short-term changes in captures occurred after the 1984 herbicide application. (Authors' abstract)

Citation Number 96
Darden, T. L. 1980. Bird communities in managed loblolly-shortleaf pine stands in East Central Mississippi. M.S. Thesis, Mississippi State University, Mississippi State. 117pp.

Bird communities during breeding and winter seasons were measured in 17 loblolly and shortleaf pine stands in east central Mississippi during 1975 and 1976. Bird diversity was evaluated in relation to (1) habitat structure and (2) forest management practices. Areas [site prepared by mist-blowing (2,4,5-T) and injecting (2,4-D)] resulted in higher values for avian diversity and numbers during early years [than areas that were tree-crushed and burned or sheared, raked, and bedded]. Differences in species diversity due to site preparation methods were negligible by stand age seven. (Author's summary)

Citation Number 97
Darr, G. W. 1971. White-tailed deer habitat in the Texas Rolling Plains. M.S. Thesis. Texas Technical University, Lubbock. 73pp.

A study of white-tailed deer habitat use was conducted during 1969-1971 [near] Colorado City, Texas [to] determine white-tailed deer use of habitats ... and how existing brush control practices influence the deer use of habitats. ... controlling brush by spraying herbicides [2,4,5-T] appeared to be more favorable than chaining. White-tailed deer densities increased in recently sprayed stands of the mesquite-juniper redland habitat and the sandyland ecotone, while deer density was less on chained bottomlands. (Author's summary)

Citation Number 98
Darr, G. W., and D. A. Klebenow. 1977. Deer, brush control, and livestock on the Texas Rolling Plains. Journal of Range Management 28:115-119.

White-tailed deer (*Odocoileus virginianus*) were observed by spotlight in the Rolling Plains of Texas to determine deer use of habitats and how deer were influenced by brush control practices and grazing by livestock. ... Influence of deer use from brush control practices varied in each habitat. ... Herbicides had little detrimental effect and in some situations may have been beneficial. ... (Authors' abstract)

Citation Number 99
DeFazio, J. T., Jr. 1986. Effects of tebuthiuron site preparation on white-tailed deer habitat in two mixed hardwood-southern pine forest types. M.S. Thesis, University of Georgia, Athens. 79pp.

[The impacts of tebuthiuron site preparation on white-tailed deer habitat were evaluated on 2 mixed hardwood-southern pine forest types in Georgia. Total forage biomass on treated sites did not differ from control sites on either the Coastal Plain or Piedmont area. Results of this study indicate that tebuthiuron appeared to have little consistent effect on deer habitat, and what negative impacts occurred seemed to be balanced by positive impacts on forage availability.] (KVM abstract)

Citation Number 100
DeFazio, J. T., Jr., A. E. Stone, and R. J. Warren. 1988. Effects of tebuthiuron site preparation on white-tailed deer habitat. Wildlife Society Bulletin 16:12-18.

See DeFazio, 1986.

Citation Number 101

DeFazio, J. T., Jr., R. J. Warren, A. E. Stone, S. K. Miller, and C. R. Ford. 1988. Response of deer mice populations to tebuthiuron application on two areas in Georgia. American Society of Mammalogists Annual Meeting 68:199.

[The authors] examined the effects of the herbicide tebuthiuron (3.0 kg ai/ha) on deer mice (*Peromyscus* spp.) populations in two areas with mixed southern pine-hardwood forests [by seasonal snap trap sampling]. ... On the Coastal Plain study area, the oldfield mouse (*P. polionotus*) ... tended to be greater on treated vs untreated sites in June ... and January ..., but were equal in September. ... However, these differences were not statistically significant ($P>0.05$; t-test). On the Piedmont Plateau study area, ... mean abundance for white-footed mice (*P. leucopus*) on treated vs untreated sites tended ($P>0.05$) to be equal in June ..., greater in January ..., and lower in September ... Despite the lack of statistical significance, the differences in *Peromyscus* abundances observed were closely related to herbicide-induced differences in seed and insect availability ..., thus possibly indicating an effect on important foods of deer mice. (Authors' abstract)

Citation Number 102

Dickson, J. G. 1981. Impact of forestry practices on wildlife in southern pine forests. Increasing Forest Productivity. Society of American Foresters Publication 82-01:224-230.

[The effects of forestry practices on wildlife populations in the southern coastal plain are discussed. Practices discussed include stand size, stand shape, stand age, tree species, regeneration method, site preparation methods, thinning, hardwood control, streamside management zones, snag retention, burning, and openings.] (KVM abstract)

Citation Number 103

Dodd, J. D., R. Jurries, and A. T. Weichert. 1975. Stimulating native forage production for livestock and wildlife on fallow riceland. Texas Agricultural Experiment Station, Progress Report 3325C. 8pp.

The herbicide 2,4-D was applied at 0.5, 0.75 and 1.0 pound per acre in the spring following rice production. ... The trend, evident for 2 consecutive years, was toward decreased weed density as the herbicide rate was increased. However, weed densities were higher during the second year than during the year of treatment. ... The year following treatment, grass production was increased about 800 pounds per acre where 0.5 pounds per acre of 2,4-D was applied. The 0.75- and 1.0-pound per acre treatments increased grass production more than 1 ton per acre when compared with the control. The accelerated plant succession appeared to provide habitat for the Attwater's Prairie Chicken. (Authors' abstract).

Citation Number 104

Doerr, T. B., and F. S. Guthery. 1980. Effects of shinnery oak control on lesser prairie-chicken habitat. Pp. 59-63 *in* P. A. Vohs, Jr. and F. L. Knopf, eds. Proceedings of the Prairie Grouse Symposium, Oklahoma State University.

See Doerr and Guthery (1983).

Citation Number 105

Doerr, T. B., and F. S. Guthery. 1983. Effects of tebuthiuron on lesser prairie-chicken habitat. Journal of Wildlife Management 47:1138-1142.

Tebuthiuron appears to be a promising tool for manipulation of lesser prairie-chicken habitat on shinnery oak range. Tebuthiuron applied at 0.4 kg/ha appeared to be the best single rate for sandy soils. This rate effectively controls shinnery oak and increases grass production without reducing forb [(Doerr and Guthery (1980) suggested that high forb diversity was a reasonable goal of habitat management)] and seed

production or vegetation cover. If areas are being managed only for lesser prairie-chickens, interspersion of untreated areas with areas treated at rates of 0.2 and 0.6 kg/ha may provide optimal habitat. The 0.2 and 0.6 kg/ha rates will provide adequate nesting cover and improve forb production, and the untreated areas should provide summer thermal cover and shinnery oak catkins, galls, and acorns. (Authors' conclusion)

Citation Number 106
Dwernychuk, L. W., and D. A. Boag. 1973. Effect of herbicide induced changes in vegetation on nesting ducks. Canadian Field-Naturalist 87:155-165

The effect of changes in characteristics of vegetation, induced by the herbicide, 2,4-D ester, on numbers and distribution of duck nests located on two islands in a lake in Alberta was studied over a 3-year period. Application of the herbicide significantly reduced the areas dominated by broad-leaved plants and permitted the expansion of areas dominated by grasses. Ducks preferred to nest among broad-leaved plants but avoided nesting among grasses. The distribution of duck nests was aggregated with concentrations of nests in areas of preferred cover which had remained unsprayed. Numbers of nesting ducks declined over the period of study. The implications of changes in vegetation in this decline are discussed. (Authors' abstract)

Citation Number 107
Easley, J. M. 1977. Effects of chemical brush control on vegetation in pine plantations, Kemper County, Mississippi. M.S. Thesis, Mississippi State University, Mississippi State. 45pp.

[Three 4-5 year-old pine plantations in Mississippi were sprayed in 1975 and 1976 with various types and rates of herbicides for pine release. The objectives of the study were:] (1) to study the effects of herbicides on vegetative composition, (2) to determine the effects of herbicidal spraying on white-tailed deer and bobwhite quail food plants, and (3) study the effectiveness of different sprays and rates on undesirable vegetation. [Herbicides evaluated included 2,4,5-T, Dowco, diclorprop, and silvex. In general, the woody desirable category was not adversely affected by herbicides to any great extent.] An increase in grasses after treatments would have to be classed as favorable. Vines are the most important category of food for deer and vines were particularly hard-hit by the herbicide applications. A general loss of forbs was noted in the study area in the flatwoods. Forbs increased in the hills, but this was probably due to a lack of uniform coverage by the herbicides. (KVM abstract)

Citation Number 108
Eaton, R. H., and J. E. Gates. 1981. Transmission-line rights-of-way management and white-tailed deer habitat: a review. Pp. 58.1-58.7 *in* R.E. Tillman, ed. Proceedings of the Second Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

Based on a review of the literature, an examination of current rights-of-way management techniques was made to assess their effects on white-tailed deer (*Odocoileus virginianus*) habitat. Those techniques beneficial in improving habitat for deer are discussed in detail. The influence of adjacent habitat types on deer utilization are also assessed. Ways are suggested by which wildlife managers may implement this information for the benefit of deer herds. Areas needing additional research are indicated. (Authors' abstract)

Citation Number 109
Eckert, R. E., Jr., A. D. Bruner, and G. J. Klomp. 1972. Response of understory species following herbicidal control of low sagebrush. Journal of Range Management 25:280-285.

[Control of low sagebrush with 2,4-D in northern Nevada increased productivity of understory grass species. Sage grouse are dependent upon sagebrush species and associated forbs as a major part of their diet. Herbicidal control of low sagebrush will destroy this habitat. Therefore, to maintain sage grouse habitat,

large-scale low sagebrush control projects should be joint ventures between the land management agencies and wildlife interests to select sites for treatment.] (KVM abstract)

Citation Number 110

Eckert, R. E., Jr., A. D. Bruner, G. J. Klomp, and F. F. Peterson. 1973. Control of Rocky Mountain iris and vegetative response on mountain meadows. Journal of Range Management 26:352-355.

Application of 2, 3, or 4 lb/acre of 2,4-D in mid-June or 3 or 4 lb/acre in early July gave 91 to 100% control of iris. Iris phenology at treatment ranged from late vegetative to late bloom. ... Slender wheatgrass and Nevada bluegrass were the most responsive species. Yield of sage grouse food plants, dandelion and yarrow, was severely reduced the first year after all treatments. Total forb production was deficient or minimal for sage grouse, and dandelion was deficient. Total forb production and dandelion component appeared adequate for existing sage grouse populations in the second and subsequent years after treatment. (Authors' abstract)

Citation Number 111

Eckert, R. E., Jr. 1983. Methods for improving mountain meadow communities. Pp. 67-75 *in* S.B. Monsen and N. Shaw, compilers. Managing Intermountain Rangeland - Improvement of Range and Wildlife Habitat. United States Department of Agriculture, Forest Service, General Technical Report INT-157.

Mountain meadow communities are not producing to their potential. This paper describes five ways to improve these communities for livestock, wildlife, and site stability. Methods discussed are weed control and seeding, iris control [using 2,4-D], tree and shrub transplants, check dams, and grazing management. (Author's abstract)

Citation Number 112

Edwards, M. B., and B. D. Shiver. 1993. Can forest site preparation benefit stand-level diversity? Pp. 120-123 *in* D. H. Gjerstad, ed. Proceedings of the International Conference on Forest Vegetation and Management - Ecology, Practice, and Policy. Auburn University, School of Forestry Report 1993:1.

... A silvicultural perspective is presented which includes a new forest stand-level index for diversity calculations, Silviculture Diversity Index (SDI). ... The SDI encorporates the herbaceous as well as the woody components and presents a more complete description of stand level diversity [including wildlife foods]. The new diversity index as well as ... traditional indices are calculated for 10 different site preparation treatments [a control, an intensive mechanical treatment, and 8 chemical treatments] in the Georgia Piedmont. Results indicate that only two treatments decreased biodiversity after 5 years. The greatest decrease was found in the control - an indication that silvicultural practices can be beneficial in creating and maintaining diversity in young pine stands. All but one ... treatment actually increased biodiversity as compared to initial conditions. (Authors' abstract)

Citation Number 113

Egler, F. E. 1953. Our disregarded rights-of-way - Ten million unused wildlife acres. Transactions of the North American Wildlife Conference 18:147-157.

[The author discusses the botanical problems involved with various types of spraying with 2,4-D and 2,4,5-T, the techniques involved, the botanical results, the relationships to wildlife food and cover, and relative future costs due to reinvading tree seedlings.] (KVM abstract)

Citation Number 114
Egler, F. E. 1968. Herbicides. Pp. 252-255 *in* F.B. Golley and H.K. Buechner, eds. A practical guide to the study of the productivity of large herbivores. IBP Handbook No. 7. Blackwell, Oxford.

[Recommendations on the use of herbicides for wildlife habitat management are provided. The author concludes that vegetation management with herbicides is a new development with huge potential.] (KVM abstract)

Citation Number 115
Ehrenreich, J. H., and R. F. Buttery. 1960. Increasing forage on Ozark wooded range. United States Department of Agriculture, Forest Service, Central States Forest Experiment Station, Technical Paper 177. 10 pp.

[A study in 1956 on the Sinkin Experimental Forest near Salem, Missouri compared the following treatments: (1) burning in early spring to remove litter and kill understory hardwoods; (2) burning in early spring and girdling of overstory trees; (3) poisoning both overstory and understory trees; (4) treating trees as in (3) and applying lime and fertilizer according to soil tests; and (5) check. By the second growing season, treatments 2 and 3 increased herbage production 40-60 times that of the control while burning alone (1) resulted in only 2-3 fold increases.] (KVM abstract)

Citation Number 116
Eschholz, W., K. Raymond, and F. Servello. 1992. Herbicide effects on habitat and nutritional ecology of moose and deer in Maine. Cooperative Forestry Research Unit Report 31. Maine Agricultural Experiment Station Miscellaneous Report 376: 31-34.

[The authors report results from the second year of a three year project to: 1) determine the effects of glyphosate on winter browse availability and digestible energy and protein availability for moose, 1-2 and 7-10 years post-treatment, 2) determine the effects of glyphosate on winter browse utilization and diet quality for moose, 1-2 and 7-10 years post-treatment, 3) determine if intensity of stand use by moose differs between glyphosate-treated and untreated stands, 4) determine the effects of landscape-scale habitat characteristics on moose use of glyphosate-treated and untreated stands, 5) determine the effects of browse availability and stand characteristics (cover) on moose use of glyphosate-treated and untreated stands, and 6) determine the effects of glyphosate on food availability for deer, 1-2 and 7-10 years post-treatment.] (DLH abstract)

Citation Number 117
Evans, P. R. 1986. Use of the herbicide 'Dalapon' for control of *Spartina* encroaching on intertidal mudflats: beneficial effects on shorebirds. Colonial Waterbirds 9:171-175.

Shorebirds, particularly Redshank (*Tringa totanus*), fed more on areas recently cleared from intertidal cord-grass flats (*Spartina*) than on areas cleared 3-4 years before, and much more than within untreated swards of this cord-grass. Recently cleared areas did not always hold highest absolute densities of invertebrates important as bird foods, but those areas remained wetter during low tide and were more open in character than other zones. The long-term efficacy of control of *Spartina* with a single dose of 'Dalapon' has yet to be established. (Author's abstract)

Citation Number 118
Evans, P. R. 1986. Use of the herbicide "Dalapon" for control of *Spartina* encroaching on intertidal mudflats: beneficial effects on shorebirds. Pacific Seabird Group Bulletin 13:26-27.

See Evans (1986) above.

Citation Number 119

Evans, R. A., J. A. Young, and R. E. Eckert, Jr. 1983. The application and use of herbicides for brush and weed control. Pp. 32-38 *in* S.B. Monsen and N. Shaw, compilers. Managing Intermountain Rangeland - Improvement of Range and Wildlife Habitats. United States Department of Agriculture, Forest Service, General Technical Report INT-157

Use of herbicide provides effective and efficient control of brush and herbaceous weeds in the management of the sagebrush-grass ecosystem. Rabbitbush [*Chrysothamnus* spp.] and other root or crown-sprouting shrubs are harder to control than sagebrush and require careful timing of spraying or a wider spectrum of herbicides. Techniques have been developed for control of downy brome and other herbaceous weeds when seeding perennial grasses for improvement of degraded sagebrush rangelands. Weed control-seeding systems, involving control of brush and herbaceous weeds plus seeding of forage and browse species, have been successful in the conversion of degraded communities to stable, high-producing rangelands. [Herbicides discussed include 2,4-D, picloram, dicamba, and tebuthiuron.] (Authors' abstract)

Citation Number 120

Fagerstone, K. A., H. P. Tietjen, and G. K. LaVoie. 1977. Effects of range treatment with 2,4-D on prairie dog diet. Journal of Range Management 30:57-60.

Two established prairie dog colonies in Montana were studied to determine the effect of range treatment with 2,4-D on prairie dogs' diet. ... There was a significant reduction in foliar cover by forbs and shrubs on the treated colony but no change on the untreated colony. Foliar cover by grass did not change significantly on either area. ... Before spraying, prairie dogs ate 73% forbs and 5% grass. Afterward, they ate 9% forbs and 82% grass. The availability of these foods appeared to be responsible for the diet change. Despite the change in diet, the 2,4-D treatment appeared to have little detrimental effects on prairie dogs. They remained in good condition after treatment, as indicated by body weight, and there was no significant difference in prairie dog activity between the treated and untreated colonies. ... (Authors' abstract)

Citation Number 121

Foster, C. H. W. 1956. Wildlife use of utility rights-of-way in Michigan. M.S. Thesis, University of Michigan, Ann Arbor. 90pp.

[Among other points summarized, the author lists the following:] A general discussion of herbicides was presented with a more detailed consideration of the three most commonly employed: ammate, 2,4-D, and 2,4,5-T. Since most public utilities have at their disposal several methods of brush control, a real opportunity exists for consideration of wildlife without interference with the primary function of the rights-of-way. (Author's summary)

Citation Number 122

Freedman, B., A. M. Poirier, R. Morash, and F. Scott. 1988. Effects of the herbicide 2,4,5-T on the habitat and abundance of breeding birds and small mammals of a conifer clearcut in Nova Scotia. Canadian Field-Naturalist 102:6-11.

After the silvicultural herbicide spraying of a conifer clearcut in Nova Scotia, the foliage cover of shrub-sized plants was reduced by an average factor of 41% compared with the pre-spray condition, while during the same period an unsprayed reference plot increased in cover by a factor of 29%. Shrub-sized plants on the sprayed plots were also reduced in stem density (by 31%) and basal area (67%). ... However, vegetation on the sprayed plots was still abundant, and the habitat changes were not sufficient to cause an important difference in the abundance, species richness, and diversity of breeding birds and mammals between sprayed and unsprayed plots. The total bird density was 71 pairs/10 ha on the unsprayed clearcut plot, 76 and 77 pr/10 ha on two plots sprayed at the prescribed silvicultural rate of 3 kg 2,4,5-T/ha, and 50

pr/10 ha on a plot sprayed at 6 kg/ha. The abundance of small mammals on these same treatment-plots was 12.8, 14.3, 13.5, and 11.7 per 100 trap-nights. (Authors' abstract)

Citation Number 123

Freedman, B. 1991. Controversy over the use of herbicides in forestry, with particular reference to glyphosate usage. Journal of Environmental Science and Health C8:277-286.

[Some of the environmental effects of herbicide use in forestry are discussed, with particular reference to a commonly used organophosphonate herbicide, glyphosate. Included is a discussion of the effects of glyphosate spraying on wildlife and their habitats.] (DLH abstract)

Citation Number 124

Freedman, B., R. Morash, and D. S. MacKinnon. 1992. Effects of the silvicultural use of the herbicide glyphosate on vegetation and breeding birds of regenerating clearcuts in Nova Scotia, Canada. Pp. 108 *in* D. H. Gjerstad and G. R. Glover, compilers. Proceedings of the International Conference on Forest Vegetation Management - Ecology, Practice, and Policy. Auburn University, School of Forestry Report 1992:1.

See Mackinnon and Freedman (1993).

Citation Number 125

Gibbens, R. P., C. H. Herbel, H. L. Morton, W. C. Lindemann, J. A. Ryder-White, D. B. Richman, E. W. Huddleston, W. H. Conley, C. A. Davis, J. A. Reitzel, D. M. Anderson, and A. Guiao. 1986. Some impacts of 2,4,5-T on a mesquite duneland ecosystem in southern New Mexico: a synthesis. Journal of Range Management 39:320-326.

Two aerial applications of 2,4,5-T ... were applied to 3,634 ha of mesquite (*Prosopis glandulosa* Torr. var. *glandulosa*) duneland in southern New Mexico. Herbicidal residuals; herbaceous plant production; soil microorganisms, insect, small mammal, and bird populations; cattle weights; travel; time budgets; and diets were studied on the treated area and an adjacent, untreated area. [Herbaceous plant] production was greater on the sprayed than on the unsprayed area for the first 3 years and was about the same for both areas for the next 2 years. ... Population statistics for small mammals were similar on both treatments. More bird species were found on untreated than on sprayed areas. Overall, the 2,4,5-T treatment caused relatively minor perturbations in measured ecosystem components.

(Authors' abstract)

Citation Number 126

Giesen, K. M., and J. W. Connelly. 1993. Guidelines for management of Colombian sharp-tailed grouse habitats. Wildlife Society Bulletin 21:325-333.

[Herbicide spraying (primarily 2,4-D) of Columbian sharp-tailed grouse habitat has a negative effect on the species because of detrimental impacts to deciduous shrubs, especially snowberry, serviceberry, chokeberry, and hawthorn. Impacts include loss of nesting, brood, and winter cover. Manipulation or alteration of vegetation within the breeding complex (i.e. within a 2-km radius of lek sites) during the nesting period (Mar-Jun) should be avoided. Management practices should not reduce height, canopy cover, or density of shrub species important for nesting. Manipulation or disturbance of vegetation (including herbicide application) that results in long-term (i.e. >5 yr) or permanent reduction of height, canopy cover, or density of mountain shrub habitats within occupied ranges should be avoided if shrubs comprise <10% of the cover within the occupied areas.] (DLH abstract).

Citation Number 127
Goodrum, P. D., and V. H. Reid. 1956. Wildlife implications of hardwood and brush control. Transactions of the North American Wildlife Conference 21:127-141.

[The purpose of this paper was to show the growth and development of means to control environments and the lack of parallel studies to show the possible impact of such efforts on wildlife. A number of examples are presented that point out how vegetation control through the use of herbicides can benefit wildlife. Little is known of the effects of herbicides on habitats and the wildlife therein. It is obvious that control operations may result in both good and bad effects on wildlife, and range and forest owners are entitled to know what these effects are.] (KVM abstract)

Citation Number 128
Goodrum, P. D. 1960. Herbicides in relation to forest wildlife management in the southern United States. Proceedings of the Fifth World Forestry Congress 3:1816-1817.

The use of phytocides in forest management may be detrimental or beneficial to wildlife, depending upon the purpose and method of application. ... Repeated applications may also kill, or seriously reduce, the production of deer browse plants and of seed from understory trees and shrubs. ... It appears that single applications of certain chemicals will greatly increase available deer forage of some species after the first year of application, but will top-kill most of the larger trees which are the best producers of mast. ... There is a pressing need for evaluating the effects of various phytocide application methods on wildlife populations and for learning what degree of hardwood control is permissible while retaining basic wildlife values. [Author's conclusions)

Citation Number 129
Grue, C. E., L. R. DeWeese, P. Mineau, G. A. Swanson, J. R. Foster, P. A. Arnold, J. N. Huckins, P. J. Sheehan, W. K. Marshall, and A. P. Ludden. 1986. Potential impacts of agricultural chemicals on waterfowl and other wildlife inhabiting prairie wetlands: an evaluation of research needs and approaches. Transactions of the North American Wildlife and Natural Resources Conference 51:357-383.

The potential for agricultural chemicals [insecticides, herbicides, fertilizers] to enter prairie-pothole wetlands and impact wildlife dependent on these wetlands for survival and reproduction appears to be great. However, the actual risk to wetland wildlife from the inputs of these chemicals cannot be adequately assessed at this time, because of insufficient data. ... (Authors' summary)

Citation Number 130
Gruver, B. J. 1984. Management and live-brush density effects on avifauna in northwest Texas. Ph.D. Thesis, Texas Tech. University, Lubbock. 369pp.

The objectives of the study were to determine the response of game- and nongame-bird populations to lowered live brush densities due to herbicide treatment [2,4,5-T], the effectiveness of management to favor game birds, the response of bobwhite parasites to game-bird management, and the effects of game-bird management on nongame bird populations. The study was conducted in Dickens and King Counties, Texas, from June 1981 to July 1983. ... The study indicated game- and nongame-bird population densities were not affected by lowered live-brush densities due to treatment in areas where dead brush was left standing. ... (Author's abstract)

Citation Number 131
Gruver, B. J., and F. S. Guthery. 1986. Effects of brush control and game-bird management on non-game birds. Journal of Range Management 39:251-253.

[The authors] observed the responses of nongame birds to brush suppression and habitat management for game birds in the Rolling Plains of Texas during 1981-1983. Data from line transects were used to describe density, species diversity, species richness, and equitability. [They] observed no difference in these variables between untreated sites and sites late sprayed with herbicides in 1969. ... On the study area, past herbicide treatment [2,4,5-T] of mesquite (*Prosopis grandulosa*) and habitat management for game birds were compatible with nongame birds. (Authors' abstract)

Citation Number 132
Guthery, F. S., T. E. Shupe, L. J. Bareiss, and C. E. Russell. 1987. Responses of selected plants to herbicide treatment of disturbed soil. Wildlife Society Bulletin 15:247-251.

[As potential wildlife habitat management techniques, the [authors] determined the effects of 14 herbicide treatments of autumn-disturbed soil on summer canopy coverage by forbs, grasses, crotons, and common sunflower and on species diversity on sandy loam soils in Kleberg County, Texas. Tebuthiuron, bromacil at 1.6 kg/ha, simazine, and hexazinone reduced coverage by forbs. Grass coverage increased at rates of 1.1 kg/ha for tebuthiuron and 4.3 kg/ha for simazine. Application of diuron at 4.3 kg/ha and diuron-bromacil at 0.5 kg/ha was cost effective in increasing the canopy coverage of crotons; a metolachlor treatment was cost effective in stimulating common sunflower. Twelve of the 14 treatments reduced plant diversity. [Other herbicides tested included oryzalin and oxyfluorfen.] (Authors' summary)

Citation Number 133
Gysel, L. W. 1957. Effects of different methods of releasing pine on wildlife food and cover. Down-To-Earth 13:2-3.

From 1950 to 1952 a series of experiments was installed by the Lake States Experiment Station at the Pine River Experimental Forest, in Lower Michigan National Forest to compare various axe and chemical methods for eliminating the overstory oaks to release the valuable pine. After the release, dense ground cover of grasses and other herbs, taller berry-producing shrubs, tree sprouts, and red pine made environmental conditions which appeared to be ideal for deer, rabbits, grouse, and other forest animals. Low growing food and cover are especially important for wildlife in the oak type because of the lack of these animal requirements in the present uncut stands. [Herbicides used included 2,4-D and 2,4,5-T.] (KVM abstract)

Citation Number 134
Gysel, L. W. 1962. Vegetation and animal use of a powerline right-of-way in southern Michigan. Michigan Agricultural Experiment Station, Quarterly Bulletin 44:697-713

During this 5-year study, various plant communities in a mile of power line right-of-way through the Kellog Forest in Michigan were analyzed in detail to determine plant composition and density. [Selective foliage or basal sprays of 2,4,5-T were applied to designated communities.] The availability of food and cover for wildlife and results of a study of animal use of the right-of-way are reported. Animal use was apparently not directly affected by the herbicide, but by the composition and density of the vegetation in the rights-of-way and in the adjacent types. (KVM abstract)

Citation Number 135
Gysel, L. W. 1962. Vegetation changes and animal use of a powerline right-of-way after the application of an herbicide. Down-To-Earth 18:7-10.

This paper is a condensation of Gysel, 1962, above.

Citation Number 136
Halls, L. K., and H. S. Crawford. 1965. Vegetation response to an Ozark woodland spraying. Journal of Range Management 32:338-340.

Aerial spraying of an Ozark woodland with 2,4,5-T temporarily increased yields of grasses preferred by cattle. Reinvasion of woody plants and heavy grazing by cattle contributed to a subsequent decline in yields of grass. The invading shrubs included many species preferred by deer. (Authors' abstract)

Citation Number 137
Hamilton, K. C., and K. P. Buckholtz. 1953. Use of herbicides for establishing food patches. Journal of Wildlife Management 17:509-516.

Six crops were sprayed pre-emergence with six chemicals in 1951 and plots of corn and soybeans were treated preemergence, at emergence, and post-emergence with three chemicals in 1952 [near Madison, Wisconsin] to investigate the possible value of herbicides in the establishment of food patches for upland game birds. [Chemicals included TCA, CMU, endothal, DN, CIPC, 2,4-D.] Initial control of weeds, the yield of weed seed, and weed cover on chemically treated plots varied with the herbicide and its rate and date of application. [The use of herbicides is] a distinct possibility for establishing food patches for upland game birds. (Authors' summary)

Citation Number 138
Hansen, R. M., and A. L. Ward. 1966. Some relations of pocket gophers to rangelands on Grand Mesa, Colorado. Colorado Agricultural Experiment Station, Technical Bulletin 88. 22pp.

Pocket gophers (*Thomomys talpoides*) were studied on Grand Mesa, in west-central Colorado, with special reference to age structure, breeding characteristics, population dynamics, food habits, and herbage production on a control area and on 2,4-D-treated areas between 1956 and 1962. One year after treatment with 2,4-D pocket gophers declined by 87%. A natural die-off was also observed on the control area in 1958 which decreased the population by 74%. ... Gopher abundance appeared positively correlated with the annual production of the primary foods of the pocket gopher. ... As the 2,4-D-treated rangelands returned toward the pretreatment perennial forb type, pocket gophers increased and became more abundant than on the adjacent unsprayed control areas. ... (Authors' abstract)

Citation Number 139
Hanson, W. R. 1952. Effects of some herbicides and insecticides on biota of North Dakota marshes. Journal of Wildlife Management 16:299-308.

Five experiments with some common chemicals [including 2,4-D] were conducted in North Dakota to learn more about the effects of aerial spraying on marsh wildlife and its habitat. ... 2,4-D amine and water and 2,4-D ester and oil, reacted similarly on dicotyledonous plants and produced a heavy kill. The majority of monocotyledonous species was affected, although more so in the ester and oil spraying. (KVM abstract)

Citation Number 140
Harlow, R. F., and D. H. Van Lear. 1981. Silvicultural effects on wildlife habitat in the south (an annotated bibliography) 1953-1979. Clemson University, Department of Forestry, Technical Paper 14. 30pp.

... This annotated bibliography is a compilation of selected, published information to be used as a quick reference guide to research papers that explore the effects of silvicultural practices on wildlife habitat. Geographically, it covers the major physiographic regions in the southern United States extending from Missouri to Maryland, south to Florida and eastern Texas. ... (Authors' introduction)

Citation Number 141
Harlow, R. F., and D. H. Van Lear. 1987. Silvicultural effects on wildlife habitat in the south (an annotated bibliography) 1980-1985. Clemson University, Department of Forestry, Technical Paper 17. 42pp.

see Harlow and Van Lear (1981)

Citation Number 142
Harris, L. D. 1978. Effects of forest management practices on wildlife ecology: a list of citations. University of Florida, IMPAC Report 3(9). 108pp.

[A list of 1067 citations is provided on the effects of forest management practices on wildlife ecology. Citations are indexed by management practice (including herbicide use), wildlife group affected, habitat variable affected, and author.] (KVM abstract)

Citation Number 143
Harris, L. D., D. H. Hirth, and W. R. Marion. 1979. The development of silvicultural systems for wildlife. University of Florida, IMPAC Report 4(5). 24pp.

Presented here are critical aspects of forest wildlife biology and ecology: diversity of environmental structure and forest structural diversity. Illustrations are given to dramatize their importance. Timber management affects wildlife habitat, and we present a capsule statement of judgment regarding common management practices such as site conversion, clearcutting, site preparation [including herbicides], and planting density. The silvicultural system advocated embodies three aspects discussed in depth: methods of regeneration; the form of trees; and the orderly arrangement of the crops over the whole forest. (Authors' abstract)

Citation Number 144
Hartley, D. R., D. H. Arner, and J. W. Lipe. 1982. A comparison of right-of-way maintenance treatments and use by wildlife. Pp. 623-629 *in* A.F. Crabtree, ed. Proceedings of the Third Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

A comparison was made of deer, cottontail rabbit, and nongame bird usage of two power line rights-of-way (ROW) which were maintained by two different techniques. One ROW had a history of maintenance by broadcast spraying of herbicides, the other ROW was a demonstration ROW maintained by multiple techniques. In 1980 and 1981, the demonstration area had approximately 3 times the usage by deer and rabbits as the sprayed ROW. Nongame bird usage also showed an increased usage of the demonstration ROW over that of the sprayed ROW. (Authors' abstract)

Citation Number 145
Hartman, G. F. 1956. New herbicides can help conservation. Wisconsin Conservation Bulletin 21:29-30.

The chemical [2,4-D and 2,4,5-T] that is doing so much in ruining good game cover along county roads, fence lines and rights-of-ways in southern Wisconsin, can by creative use, serve conservation well in our forested areas and our extensive brushy marshes. (KVM abstract)

Citation Number 146
Heady, H. F., and J. Bartolome. 1977. The Vale rangeland rehabilitation program: The desert repaired in southeastern Oregon. United States Department of Agriculture, Forest Service, Resource Bulletin LUME: PNW-70. 139pp.

This report evaluates the large-scale rangeland rehabilitation program in the Vale, Oregon, District of the Bureau of Land Management. ... The major sagebrush control practices used either disk plows or aerially applied 2,4-D. ... Extensive sampling of treated areas revealed that most attempts at land rehabilitation succeeded. ... wildlife species exhibited varied responses in relation to their particular habitat requirements, but none seems to have been damaged permanently by the land treatment ... (Authors' research summary)

Citation Number 147
Hjeljord, O., and S. Grønvold. 1988. Glyphosate application in forest - ecological aspects. V1. Browsing by moose (*Alces alces*) in relation to chemical and mechanical brush control. Scandanavian Journal of Forest Research 3:115-121.

Browse production after two growth seasons following mechanical cutting and glyphosate spraying was 60% and less than 1%, respectively, of production before treatment. Moose (*A. alces*) utilization of forest plantations decreased significantly the first and third winter after spraying. The second winter there was also a decrease, although not statistically significant. Browsing by [moose] relieved the spruce seedlings from considerable competition from hardwoods. Browsing also altered the hardwood composition of the forest plantations, from rowan (*Sorbus aucuparia*) dominance to birch (*Betula* spp.) dominance. (Authors' abstract)

Citation Number 148
Holechek, J. L. 1981. Brush control impacts on rangeland wildlife. Journal of Soil and Water Conservation 36:265-269.

[The author reviews the effects of brush control, including the use of herbicides, on range wildlife. Wildlife species discussed include white-tailed deer, mule deer, pronghorn antelope, elk, moose, bighorn sheep, sage grouse, wild turkey, bobwhite quail, mourning dove, lesser prairie chicken, Brewer's sparrow, Vesper's sparrow, and other small mammals.] (Authors' abstract)

Citation Number 149
Horejsi, R. G. 1973. Influence of brushlands on white-tailed deer diets in northcentral Texas. M.S. Thesis, Texas Tech University, Lubbock. 69pp.

[This study] indicates that problems arising with brush control programs and wildlife management center around cover removal and not forage changes. Indications are that total brush eradication over extensive areas will eliminate deer. Selective control or pattern arrangements will allow maintenance of wildlife populations. Brushy basal sprouts of mesquite and other browse species on a sprayed-chained-esprayed upland area appeared to offer adequate cover for deer. Designs that show patchwork arrangements centering around natural corridors (ravines, creeks, etc.) appear most beneficial. (KVM abstract)

Citation Number 150
Hull, A. C., Jr. 1971. Effect of spraying with 2,4-D upon abundance of pocket gophers in Franklin Basin, Idaho. Journal of Range Management 24:230-232.

Four 50 x 50 foot plots were sprayed with 2 lb/acre 2,4-D in 1959, 1960, 1965, and 1969 to kill fleshy-rooted, spring-growing plants and annuals. These plants are the major source of food for pocket gophers. Averaging the 10-year period, 1960-1969, spraying reduced gopher mounds by 93% and winter casts by 94% when compared to the unsprayed areas. (Authors' abstract)

Citation Number 151
Huntley, J. C. 1977. The effects of several utility rights-of-way maintenance techniques on game food plants. M.S. Thesis, Mississippi State University, Mississippi State. 95pp.

Six utility rights of way maintenance techniques [winter burn, mow, disk, hand clear, selective basal spray, and aerial spray with 2,4,5-T] were studied to determine their effects on density of quail food plants, grasses not considered quail food, woody vegetation, and other vegetation. ... Winter burning with fertilizer produced significantly more quail food plants than all other treatments. Winter burning without fertilizer produced significantly more quail food plants than aerial and selective basal spraying, but not more than mowing. ... Selective basal spraying was the most effective technique at controlling undesirable woody plants. ... (Author's abstract)

Citation Number 152
Huntley, J. C., and D. H. Arner. 1981. The effect of utility right-of-way maintenance upon game food plants. Pp. 31.1-31.13 *in* R.E. Tillman, ed. Proceedings of the Second Symposium, Environmental Concerns in Rights-of-Way Management, Mississippi State University.

Maintenance techniques for utility rights-of-way were studied to determine their effects on density of vegetation. The techniques included winter burning, mowing, disking, hand clearing, selective basal spraying, and aerial spraying [2,4,5-T]. The effects of fertilizing and seeding were also determined. Winter burning with fertilizer produced significantly more quail food plants than all other treatments. Winter burning without fertilizer produced significantly more quail food plants than did aerial and selective basal spraying, but not more than mowing. ... Selective basal spraying was the most cost effective in controlling unwanted woody plants. ... Cost data are given for all treatments. Research areas were located in the Gulf Upper Coastal Plain. (Authors' abstract)

Citation Number 153
Hurst, G. 1988. Herbicides and wildlife: all the news ain't bad. Proceedings of the 34th Annual Mountain Lake Vegetation Management Council, Incorporated 5:53-66.

... Following intensive mechanical site prep ... and an application of Hexazinone (Velpar or Pronone), total plant biomass, amount of selected deer forage, and number of plant species decreased during the first growing season in a loblolly pine plantation. However, at the end of the second growing season there were no significnat differences in plant characteristics between herbicide-treated and not treated plots. Two important wildlife plants, dove weed and pokeweed were resistant to Hexazinone. When Imazapyr (Arsenal) was used as part of the site prep, similar results, i.e., recovery by the plant community in the second growing season, were found. The "brown and burn" site prep method, using Pronone 10G and broadcast burning, resulted in plant communities dominated by forbs the first growing season. ... Herbicides (Arsenal, Pronone, Velpar), when used to control hardwood brush in 4 to 5-year old pine plantations, resulted in an increase in selected deer forage, mainly forbs. ... Blackberry and many legumes, important wildlife plants, were resistant to Arsenal. ... (Author's abstract)

Citation Number 154
Hurst, G. A., and T. R. Bourland. 1980. Hardwood density and species composition in bottomland areas treated for regeneration. Southern Journal of Applied Forestry 4:122-127.

Seedling and sapling density of high- and low-commercial species varied from 994 to 2,792/acre on regenerated areas, age 3 to 8 years, on the Delta National Forest, Mississippi. The highest densities were in the oldest regenerated stands, on low flat sites and on areas that had not been hand-injected [with 2,4-D]. ... [Effects of timber management policies on wildlife are mentioned.] (KVM abstract)

Citation Number 155

Hurst, G. A., and R. C. Warren. 1980. Intensive pine plantation management and white-tailed deer habitat. Pp. 90-102 *in* R.H. Chabrech and R.H. Mills, eds. Integrating Timber and Wildlife Management in Southern Forests. Louisiana State University Forestry Symposium 29.

[A study of the effects of intensive pine plantation management on deer habitat in the interior flatwoods of Mississippi began in 1971. Deer habitat suitability (forage availability) was assessed according to type of site preparation used (mist-blown and tree-injected, tree-crushed and burned, or bedded). In addition, the effects of thinning, burning, fertilizing, and chemical brush control on deer habitat were investigated. The authors conclude that deer habitat was adversely affected and benefitted by plantation management. Intensive pine plantation management can produce good habitat on a short or long rotation. Herbicides evaluated included 2,4,5-T, dowco, silvex, and dichlorprop.]

(KVM abstract)

Citation Number 156

Hurst, G. A., and R. C. Warren. 1981. Enhancing white-tailed deer habitat of pine plantations by intensive management. Mississippi Agricultural Forest Experiment Station, Technical Bulletin 107. 8pp.

[The effects of various pine plantation management strategies on habitat for white-tailed deer are discussed. These strategies include type of site preparation, age of the plantation, brush control with 2,4,5-T, controlled burning and thinning, thinning and fertilizing, roads, and supplemental practices. Recommendations for improving deer habitat in pine plantations, natural forests, and along stream management zones are provided.] (KVM abstract)

Citation Number 157

Hurst, G. A., and R. C. Warren. 1982. Impacts of silvicultural practices in loblolly pine plantations on white-tailed deer habitat. Pp. 484-487 *in* E.P. Jones, ed. Proceedings of the Second Biennial Southern Silvicultural Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SE-24.

Silvicultural practices such as burning, thinning, spraying, and fertilizing within pine plantations impact on white-tailed deer food (forage, mast) quantity, quality, digestibility, palatability, and availability. Other aspects of deer food, namely diversity, stability, and distribution (spatial, seasonal), and cover are affected by practices within and between plantations, such as setting (stand), site preparation, size, shape and situation (interspersion). (Authors' abstract)

Citation Number 158

Hurst, G. A., and R. C. Warren. 1986. Deer forage on pine plantations after a herbicide application for pine release. Proceedings of the Southern Weed Science Society 39:238.

Preferred white-tailed deer (*Odocoileus virginianus*) forage abundance was determined in loblolly pine (*Pinus taeda*) plantations in the Upper Coastal Plain (hills) of Pickens County (PCP), Alabama, and a plantation in Webster County (WCP), Mississippi. ... The PCP was planted in December 1978 and received an aerial application of Velpar-sintered clay granules (10%), 2 lbs/ac, in May 1982. ... The WPC was planted in February 1978 and received an aerial application of Pronone 10G, 2 lbs/ac, in May 1982. ... Total deer forage in the PCP was significantly greater ($P>0.05$) on treated plots (838 lbs/ac) than on control plots (554 lbs/ac) in September. ... Total deer forage in the WCP in September was also significantly greater on the treated (877 lbs/ac) than on control (472 lbs/ac) plots. ... (Authors' abstract)

Citation Number 159
Hurst, G. A. 1987. Vegetative responses to imazapyr for pine release. Proceedings of the Southern Weed Science Society 40:247.

Vegetative responses were studied in 3 loblolly pine (*Pinus taeda*) plantations in east-central Mississippi following an aerial application of Arsenal(R) (imazapyr) for pine release. ... Arsenal was applied at 0.5, 0.75, and 1.0 lb/ac a.i., with and without surfactant. ... Generally, plant occupancy by grasses and woody plants decreased while that by forbs and vines increased after Arsenal treatment. More plant species were found on line transects on treated plots than on control plots. Legumes, e.g. *Lespedeza* spp. were resistant to imazapyr. Deer forage was generally greater on treated plots, particularly those treated in June. Deer forage shifted from woody browse to forbs and vines. The very important vines, blackberry and dewberry (*Rubus* spp.), were resistant to imazapyr even at 1 lb/ac. (Author's abstract)

Citation Number 160
Hurst, G. A., and P. M. Blake. 1987. Plant species composition following hexazinone treatment-site preparation. Proceedings of the Southern Weed Science Society 40:194.

Plant species composition was studied on a loblolly pine (*Pinus taeda*) plantation in Oktibbeha County Mississippi. A mature pine-hardwood forest ... was clearcut and the site prepared by shear, windrow (burn), single disk, and bed in late 1983. ... In March 1984, 1 plot in each [of 5] blocks received an aerial application ... of Pronone(R) 5G (hexazinone) at 1 lb/ac a.i., another plot received a banded (5 ft wide) application on the bed by backpack sprayer of Velpar(R) (hexazinone), and a third plot was not treated. ... At the end of the first growing season after herbicide treatment, plant species composition was very similar on banded and control subplots, with fewer species on the broadcast treatment subplots. However, at the end of the second growing season herbicide treated subplots had more species of grasses, legumes, vines, woody, and sedges than control subplots. Only forb species were more numerous on control than on herbicide treated plots. (Authors' abstract)

Citation Number 161
Hurst, G. A. 1988. Vegetation following imazapyr for site prep. Proceedings of the Southern Weed Science Society 41:201.

Vegetation on a loblolly pine (*Pinus taeda*) plantation in Monroe County, MS was studied at age 1 and 2 years. ... An aerial application of Imazapyr (Arsenal) was applied at 0.75, 1.0, and 1.5 lbs/ac to one 5 acre plot for each rate. Total deer forage (age 1) averaged 193 lbs/ac on control and 126 lbs/ac on treated plots. At age 2 forage on control plots was 171 lbs/ac and forage on treated plots averaged 102 lbs/ac. A drought in the summer/fall of 1987 reduced deer forb forage. Average forage for the 2 years by plant category, control vs. treated, was grass 7 to 12, forb 25 to 51, vine 122 to 70, and woody 6 to 3. ... (Author's abstract)

Citation Number 162
Hurst, G. A., and W. E. Palmer. 1988. Vegetative responses to hexazinone for site prep. Proceedings of the Southern Weed Science Society 41:210.

Vegetation on a 1 year old ... and a 2 year old ... loblolly pine (*Pinus taeda*) plantation was studied in September 1987. ... Site prep consisted of an aerial application of 30 lbs/ac of Pronone 10G (hexazinone) followed by a broadcast burn in late summer. ... Site preparation by herbicide and burn resulted in a plant community dominated by forbs. The presence of many dead trees (snags) provided excellent habitat for cavity nesting birds. Forage for deer was mostly forbs. However, the 2-year-old plantation had many legumes and was excellent northern bobwhite (*Colinus virginianus*) habitat. (Authors' abstract)

Citation Number 163
Hurst, G. A. 1989. Forestry chemicals and wildlife habitat. Forest Farmer 48:10-11.

[The author reviews the findings from 15 years of research on the effects of forestry chemicals on wildlife habitat in Mississippi. The author concludes that chemicals are a tool for improving certain aspects of some wildlife species habitat. Intensively managed plantations create good deer, quail, rabbit, and wild turkey habitat. Herbicides discussed include 2,4-D, 2,4,5-T, hexazinone, and imazapyr.] (KVM abstract)

Citation Number 164
Inglis, J. M. 1985. Wildlife management and IBMS. Integrated brush management systems for South Texas: Development and implementation. Texas Agricultural Experiment Station, Bulletin 1493:35-40.

[The author discusses the implications of brush management, including herbicides, to wildlife management in South Texas. Wildlife species discussed include white-tailed deer, bobwhite quail, scaled quail, and javelina.] (KVM abstract)

Citation Number 165
Jahn, L. R., and B. H. Popov. 1956. A preliminary report on the experimental use of herbicides in Wisconsin to control and manipulate bog type vegetation for waterfowl. Proceedings of the North Central Weed Control Conference 13:29-30.

[In 1954, the Wisconsin Conservation Department carried out experimental herbicide treatments of leatherleaf (*Chamaedaphne calyculata*) to determine the relative effectiveness of 2,4-D and 2,4,5-T and if 2,4-D and 2,4,5-T can be used to modify the normal plant succession in bogs and thereby increase their value for waterfowl. Top growth of leatherleaf was partially controlled temporarily with one treatment of either 2,4-D or 2,4,5-T. However, resprouting from the extensive root system takes place in the first year. Even with herbicide manipulation of the bog type plant succession, intensive management appears necessary to produce desirable plants in an unfavorable environment in reasonable quantities for waterfowl.] (KVM abstract)

Citation Number 166
Jenkins, B. C. 1955. Wildlife habitat development with herbicides in Michigan. Proceedings of the North Central Weed Control Conference 12:58.

[This paper presents some of the problems of wildlife habitat management that herbicides may help to solve; outlines briefly the field tests made in Michigan; and encourages the development of even more effective herbicides and better methods of using them. Use of herbicides in habitat management for sharp-tailed grouse, white-tailed deer, waterfowl, and woodchuck is discussed. Herbicides used include TCA and dalapon.] (KVM abstract)

Citation Number 167
Johnson, D. R. 1964. Effects of range treatment with 2,4-D on food habits of rodents. Ecology 45:241-249.

The food habits of rodents inhabiting shrub grasses and perennial forb ranges in western Colorado were investigated to determine the kinds and proportions of foods eaten, the effects of range treatment with 2,4-D on food habits, and the degree of competition for food among rodents inhabiting these ranges. ... Grass seeds comprised a larger proportion and forb and shrub seeds a smaller proportion of the diet of deer mice inhabiting areas treated with 2,4-D than that for untreated areas. The availability of these food items appeared to be responsible for these observed differences in diet. ... Although there was no significant difference in diets [of least chipmunks] on treated and control areas, the influence of the availability of certain seeds was evident. Range treatment with 2,4-D had no effect on the diet of montane voles. The greater

abundance of montane voles on treated areas appeared to be due to an increase in grass cover and not to an increase in available food. ... (Author's abstract)

Citation Number 168
Johnson, D. R., and R. M. Hansen. 1969. Effects of range treatment with 2,4-D on rodent populations. Journal of Wildlife Management 33:125-132.

The treatment of perennial forb and shrub-grass ranges with 2,4-D in western Colorado usually produced an increase in grass cover and a decrease in the cover of most forbs and shrubs. Recovery time of herbicide-sensitive species varied. ... The density and litter size of the deer mouse (*Peromyscus maniculatus*) was little affected by the 2,4-D treatment. The density of northern pocket gophers (*Thomomys talpoides*) and least chipmunks (*Eutamias minimus*) was reduced. Montane voles (*Microtus montanus*) increased in abundance following treatment of a perennial forb range. With the reestablishment of forb dominance, pocket gopher and vole populations returned to pre-treatment levels. Density changes of pocket gophers on treated ranges were due primarily to changes in the availability of food, those of chipmunks to both food and cover, and those of voles to cover changes. (Authors' abstract)

Citation Number 169
Johnson, J. C. 1974. A study of clearcuts as wildlife habitat, Kemper County, Mississippi. M.S. Thesis, Mississippi State University, Mississippi State. 81pp.

Studies dealing with the productivity of fleshy fungi, vegetation (food availability studies), and mast, along with population estimates for selected animal species were conducted on loblolly pine plantations and three forested areas in the interior flatwoods of Kemper County, Mississippi. ... Bedded plantation [i.e. shear, pile, burn, bed, and plant], age 2, was significantly superior in summer food production over injected plantations [i.e. mistblown, burn, plant, and inject]. ... The bedded site treatment was superior to the injected site treatment in deer food production during the winter when the amount of food present is most important. ... it seems that the bedded site treatment is superior for deer, especially during the critical winter months. (Author's abstract and summary)

Citation Number 170
Johnson, R. R. 1975. Improving forage production and big game winter range with phenoxy herbicides. Proceedings of the Western Weed Science Society 28:40-43.

[2,4-D, silvex, 2,4,5-T,] and a 1:1 mixture of 2,4-D or 2,4,5-T and dichlorprop were aerially applied at rates of 2.24 to 3.36 kg/ha to 2.8 ha plots near Rifle and Crawford, Colorado. ... July application was supperior to August application and repeat sprays after three years. All herbicides gave similar control of Gambel oak, but silvex and dichlorprop were less effective on Saskatoon serviceberry (*Amelanchier alnifolia*), roundleaf snowberry (*Symphoricarpos rotundifolius*) and squaw-apple (*Peraphyllum amosissimum*) than 2,4,5-T or a mixture of 2,4-D and dichlorprop. (Author's abstract)

Citation Number 171
Jones, E. P., Jr. 1992. Silvicultural treatments to maintain red-cockaded woodpecker habitat. Pp. 627-632 *in* J. C. Brissette, ed. Proceedings of the Seventh Biennial Southern Silvicultural Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SO-93.

The red-cockaded woodpecker (*Picoides borealis*), an endangered species, prefers park-like stands of older sawtimber pines for its nesting habitat. Natural, 60+ -year-old stands of loblolly pine (*Pinus taeda*) and hardwood on the Hitchiti Experimental Forest and the Piedmont National Wildlife Refuge in the Lower Piedmont of Georgia were opened up by felling the hardwoods and the midstory trees and shrubs on 2-acre plots in May 1989. Five study treatments were then applied in summer and winter of 1989-90: herbicide with

summer burn, herbicide only, summer burn only, winter burn only, and untreated check. The herbicide, imazapyr in water, was applied by tractor sprayer. Third-year results showed that only herbicide with summer burning was significantly (0.05) more effective than no treatment in controlling all stems together (pines, hardwoods, and shrubs); effects on separate species groups were not significant. (Author's abstract)

Citation Number 172
Jones, W. P. 1986. Phragmites control with aerial applications of glyphosate in Delaware. Transactions Northeast Section of the Wildlife Society 43:15-24.

The common reed or phragmites (*Phragmites australis*) has expanded dramatically throughout Delaware's tidemarshes and impoundments in the last 40 years, greatly reducing the value of these wetlands as waterfowl, waterbird, and furbearer habitat. The most effective means of control appears to be repeat applications of the herbicide Rodeo, ... which contains the active ingredient glyphosate. Revegetation [following herbicide treatment] was documented on all treated areas and found to be limited ... Winter burning of phragmites following treatment appeared to have little effect on the amount of non-phragmites revegetation occurring the next season. ... Timing of phragmites reproductive stages indicates Rodeo will be effective if applied from early September through mid-October. ... (Author's abstract)

Citation Number 173
Keith, J. O., R. M. Hansen, and A. L. Ward. 1959. Effect of 2,4-D on abundance and foods of pocket gophers. Journal of Wildlife Management 23:137-145.

Aerial spraying of weedy, mountain rangeland in western Colorado with 2,4-D resulted in the following changes 1 year after treatment: 1) Pocket gopher populations were reduced 87%, 2) Production of perennial forbs was reduced 83% and grass production increased 37%, 3) The diet of pocket gophers changed from 82% forbs to 50% forbs, and from 18% grass to 50% grass. Untreated control areas showed no significant change in gopher numbers or herbage production from one year to the next. Gopher food habits did not change on untreated areas. (Authors' summary)

Citation Number 174
Kelly, C. P., and H. G. Cumming. 1992. Effects of an aerial application of Vision® on moose browse - first year results. Alces 28:101-110.

Experimental aerial treatment of 7 mixed wood areas for conifer release with Vision® at 0.80, 1.06, and 1.60 kg a.e./ha, decreased living stem densities after one winter by 36, 61 and 47% respectively on treated plots, while controls increased by 25%; thus, decreases in total numbers of living hardwood stems were not proportional to application rates. Hardwood shrub cover was reduced by application rates of 1.06 and 1.60 kg a.e./ha, but not by 0.80 kg a.e./ha. Although 1.06 kg a.e./ha reduced cover almost twice as much as the highest concentration, differences were not significant. Herbaceous ground cover was reduced approximately 20% on all treated areas when compared with control plots. Browsing rates decreased on all plots after treatment and were twice as high on controls with treated sub-blocks. However, neither differences among treatments, nor between treated and control plots were significant. (Authors' abstract)

Citation Number 175
Kennedy, E. R., and P. A. Jordan. 1985. Glyphosate and 2,4-D: the impact of two herbicides on moose browse in forest plantations. Alces 21:149-160.

Conifer plantations in northeastern Minnesota are important browse areas for moose (*Alces alces*). ... [The authors] sampled available browse in glyphosate and 2,4-D treated plantations. Three years after spraying, the glyphosate treated plantations averaged only half the available browse as the 2,4-D treated plantations. Grass and rasberries (*Rubus* spp.) are not controlled the year after spraying with glyphosate

because this herbicide has no residual effects. [The authors] ... could not measure long-term comparative effects because glyphosate was not used in this region before 1981. This report covers only the first year of a 2-year study. (Authors' abstract)

Citation Number 176
Kennedy, E. R. 1986. The impact of the herbicide glyphosate and 2,4-D on moose browse in conifer plantations in northeastern Minnesota. M.S. Thesis, University of Minnesota, Minneapolis. 27pp.

Conifer plantations in northeastern Minnesota are important browse sources for moose (*Alces alces*). ... The amount of available browse in glyphosate and 2,4-D treated plantations was estimated during the summers of 1984 and 1985. Four years after spraying, the glyphosate treated plantations averaged, at most, only half the available browse as the 2,4-D treated plantations. Further, the untreated plantations contained at least twice the browse biomass as 2,4-D treated plantations and 4 times the biomass of glyphosate treated plantations. Browse utilization was higher in the 2,4-D plantations than in the glyphosate plantations. Effective applications of glyphosate can cause a significant reduction in available browse for moose for an estimated 5 to 10 years. (Author's abstract)

Citation Number 177
Kessler, W. B., A. T. Weichert, and J. D. Dodd. 1977. Attwater prairie chicken ecology in relation to agricultural and range management practices. Texas Agricultural Experiment Station, Consolidated Progress Report 3665. 81pp.

The availability and use of Attwater greater prairie chicken habitat were investigated from 1974 to 1976 on the Attwater Prairie Chicken National Wildlife Refuge and adjacent agricultural lands in Colorado County, Texas. Rice agriculture, the dominant land use, provided preferred summer and brood-rearing cover. Fallow fields treated with dicamba, 2,4-D, and an experimental herbicide to accelerate grass establishment retained effective forb canopy for summer cover in spite of decreased forb density. Utilization - availability analysis indicated that treated and untreated fallow rice fields, of various fallow stages, were used in proportion to availability. ... (Authors' abstract)

Citation Number 178
Kessler, W. B., and J. D. Dodd. 1978. Responses of coastal prairie vegetation and Attwater prairie chickens to range management practices. Proceedings of the First International Rangeland Congress 1:473-476.

see Kessler et al. 1977.

Citation Number 179
Kilbride, K. M., F. L. Paveglio, and C. E. Grue. 1995. Control of smooth cordgrass with Rodeo® in a southwestern Washington estuary. Wildlife Society Bulletin 23:520-524.

[The authors] investigated the efficacy of aerial and ground application of Rodeo® to control smooth cordgrass (*Spartina alterniflora*)[which can displace habitat for migratory birds including geese, ducks, and shorebirds] on intertidal mudflats in Willapa Bay, Washington during 1992-1993. The herbicidal formula was applied to 2 1-ha plots using a helicopter with toe-mounted spray boom or by hand-held wand sprayer. Stem densities did not differ from pre- to post-treatment between aerially treated and control clones. Stem densities were reduced on clones where the herbicidal formulation was applied by hand. Stem density was reduced most at plots located highest in the intertidal zone. Efficacy depended on the time between treatment and subsequent tidal inundation of treated plants. (Authors' abstract)

Citation Number 180
Kimmel, R. O. 1981. Potential of landowner maintenance programs to increase wildlife benefits from powerline rights-of-way. Transactions of the Northeast Section of the Wildlife Society 38:31.

... Landowner maintenance programs on right-of-way acreage replace broadcast-herbicide maintenance with manual-selective maintenance. ... Wildlife exposure to chemical herbicides is decreased. This could be of particular importance to the recruitment of species such as wild turkey (*Meleagris gallopavo*) and ruffed grouse (*Bonasa umbellus*). Power company spray seasons usually coincide with the period when chicks are using rights-of-way for feeding. ... (Author's abstract)

Citation Number 181
Kirkland, G. L., Jr. 1978. Population and community responses of small mammals to 2,4,5-T. United States Department of Agriculture, Forest Service, Research Note PNW-314. 6pp.

The population and community responses of small mammals to application of the herbicide 2,4,5-T were studied on the Fernow Experimental Forest, Parsons, West Virginia. Data from live-trap and snap-trap sampling of small mammals before and after herbicide treatment revealed either neutral or positive responses. There was a significant correlation between the ranked order of abundance of species in pretreatment and posttreatment samples; this indicated that no major shift in community composition had occurred. Total numbers of small mammals tended to increase after aerial application of the herbicide. Shrews (Sordidae) and mice (Critecinae) increased significantly; voles (Microtinae) declined slightly. The decrease in the abundance of microtine rodents resulted from a differential decline in the abundance of diurnal species. (Author's abstract)

Citation Number 182
Kituku, V. M., and J. Powell. 1990. Forage quality of bitterbrush (*Purshia tridentata*) as affected by brush management practices. Journal of the Colorado-Wyoming Academy of Science 22:26.

Forage value of range shrubs is important for both domestic and wild ungulates; however most brush management strategies are geared to improving nutritional levels of herbaceous plants. The effects of mowing and application of 2,4-D on bitterbrush forage quality were studied in a sagebrush-bitterbrush vegetation type of southcentral Wyoming. Both treatments improved bitterbrush nutrient content in the first growing season following manipulations. Although treated bitterbrush plants and herbage were more accessible significant differences in nutrient content between treated and untreated bitterbrush plants disappeared by the second growing season following treatments. For continuous supply of high-quality browse for livestock and big game, manipulations should be done on annual basis on small plots rather than using a one-time treatment for a large area. An annual maintenance program on small areas should provide adequate cover for game animals as well as nesting birds. (Authors' abstract)

Citation Number 183
Klebenow, D. A. 1970. Sage grouse versus sage-brush control in Idaho. Journal of Range Management 23: 396-400.

Spraying with herbicides to control sagebrush was detrimental to nesting grouse and to sage grouse broods. Nesting ceased when one area was sprayed and another contained a nest five years after spraying. Broods were less affected. One area contained broods three years after it had been sprayed, but variation existed from one area to the next, for another that was sprayed in 1962 was not being used in 1966. (Author's abstract)

Citation Number 184
Krefting, L. W., H. L. Hansen, and M. H. Stenlund. 1955. Use of herbicides in inducing regrowth of mountain maple for deer browse. Minnesota Forestry Notes 42:2.

[The authors tested the relative effectiveness of 2,4-D and 2,4,5-T in stimulating regrowth of mountain maple (*Acer spicatum*) on Superior National Forest in Minnesota. Observations of the extent of browsing by deer on the regrowth indicate no aversion to the treated clumps as compared to the controls. The results indicate that in comparison with cutting of mountain maple to encourage regrowth, spraying treatments can be applied at a great saving of labor.] [KVM abstract)

Citation Number 185
Krefting, L. W., H. L. Hansen, and M. H. Stenlund. 1956. Stimulating regrowth of mountain maple for deer browse by herbicides, cutting and fire. Journal of Wildlife Management 20:434-441.

In order to stimulate regrowth and to provide more browse, [2,4-D and 2,4,5-T], fire, and diesel oil were used to top-kill mountain maple that had grown out of reach of deer in northeastern Minnesota. ... 2,4-D was generally more effective than 2,4,5-T in inducing regrowth. ... Deer browsed both one and two-year-old stems of regrowth, and even some preference was shown for the herbicide-treated clumps. (Authors' summary)

Citation Number 186
Krefting, L. W., and H. L. Hansen. 1958. Comparison of winter and spring application of 2,4-D to induce regrowth of mountain maple for deer browse. Minnesota Forestry Notes 66:2.

[Two 1-acre plots of mountain maple were sprayed with 2,4-D (12 lbs acid /100 gal fuel oil) in February and March 1956 to determine relative effectiveness at inducing regrowth. Results indicated that mid-winter application of 2,4-D results in greater mortality to the stems sprayed as well as less regrowth both in numbers of sprouts per clump and in height of the sprouts at the end of the first growing season.] (KVM abstract)

Citation Number 187
Krefting, L. W., H. L. Hansen, and R. W. Hunt. 1960. Aerial application of 2,4-D to improve the browse supply for deer. Proceedings of the Society of American Foresters:103-106.

[Aerial applications of 2,4-D were made to increase the quantity of desirable deer browse. The first year response to treatment varied consistently with the density of the overhead tree canopy. Spraying resulted in killing much large, out of reach browse, and replacing it with young sprouts and suckers readily available to deer. The cumulative effect of the spray at the end of the second year shows that there was a marked increase in the total number of stems on all cover types.] (KVM abstract)

Citation Number 188
Krefting, L. W., H. L. Hansen, and R. W. Hunt. 1960. Improving the browse supply for deer with aerial applications of 2,4-D. Minnesota Forestry Notes 95:2.

[Aerial applications of 2,4-D were made on 8 2-acre plots on the Tamarac National Wildlife Refuge. Cover types sprayed were aspen, jack pine, oak, and upland brush. Woody and herbaceous plants were tallied before and after spraying. From a deer browse improvement standpoint, the first year results were encouraging, since the greatest increase in the aspen and jack pine types was in the first preference group. The extent to which aerial applications of 2,4-D will increase the browse supply for deer will depend on the species composition of the shrubs and on the density of the tree canopy.] (KVM abstract)

Citation Number 189
Krefting, L. W. 1962. Use of silvicultural techniques for improving deer habitat in the Lake States. Journal of Forestry 60:40-42.

[This paper evaluates,] from a wildlife standpoint, the following silvicultural techniques: prescribed burning, disking and bulldozing, planting food and cover, planting openings, use of phytocides, and timber-cutting practices. [Only 2,4-D is discussed.] (KVM abstract)

Citation Number 190
Krefting, L. W., and H. L. Hansen. 1963. Use of phytocides to improve deer habitat in Minnesota. Proceedings of the Southern Weed Control Conference 16:209-216.

Tests in the Lake States have demonstrated the possibility that phytocides may be effective in creating openings needed by deer and other wildlife, in increasing the browse supply, and in establishing patches of conifer cover. It was found that 2,4-D was superior to 2,4,5-T when used to top-kill mountain maple that had grown out of reach of deer and to stimulate regrowth by sprouts. ... Aerial application of 2,4-D at 2 pounds of acid in 3.5 gallons of water per acre made to a variety of forest cover types in northwestern Minnesota were found to effectively reduce the population of low value American and beaked hazel and to favor the more desirable browse plants for deer such as chokecherry, arrow-wood, and several species of dogwood. Both the ratio and total quantity of these preferred species was increased. Two years after spraying, the grasses and sedges increased markedly. (Authors' summary)

Citation Number 191
Krefting, L. W., and H. L. Hansen. 1969. Increasing browse for deer by aerial application of 2,4-D. Journal of Wildlife Management 33:784-790.

The effectiveness of aerial applications of 2,4-D in reducing the population of hazel (*Corylus* spp.) and other low-preference browse species and increasing the supply of the better browse plants for white-tailed deer (*Odocoileus virginianus*) was studied from 1958 to 1966 in each of four cover types in Minnesota. Stem counts after 2 years and dry-weight determinations after 6 years showed that the proportions and total abundance of the better browse plants was greater on the sprayed than on control plots. Browse production after spraying varied from 22 lb on the unsprayed jack pine (*Pinus banksiana*) plot to 90 lb per acre on the sprayed upland plot. The abundance of grasses and sedges increased on all sprayed plots, though a decline began after about 4 years following spraying. The response by other herbaceous species varied by species and cover type. Deer were attracted to sprayed plots for winter browsing and summer bedding. Pellet groups were still more abundant on the treated than on the untreated areas, especially in the aspen type, when the study was terminated 8 years after spraying. (Authors' abstract)

Citation Number 192
Kufeld, R. C. 1977. Improving gambel oak ranges for elk and mule deer by spraying with 2,4,5-TP. Journal of Range Management 30:53-57.

Areas of Gambel oak vegetation in northwestern Colorado were sprayed with 2,4,5-TP to evaluate effects on plant abundance and deer and elk use 2 and 5 years after treatment. Grasses increased in abundance 44% after 2 years; shrubs and forbs decreased 29 and 15%, respectively. After 5 years, grasses and shrubs were 17 and 7%, respectively, above pretreatment levels of abundance; forbs were 4% below. Total vegetation on the treated area decreased 4% after 2 years, while a 5% increase was recorded after 5 years. Elk and deer use on the sprayed area increased 73 and 16%, respectively, 2 years after spraying. After 5 years elk use was 11% above pretreatment levels and deer use was 21% below. If 2,4,5-TP is used to spray Gambel oak to modify plant composition and increase elk and deer use, the area should be resprayed at 3-year intervals, indefinitely, if the improved situation is to be maintained. (Author's abstract)

Citation Number 193
Kufeld, R. C. 1983. Responses of elk, mule deer, cattle, and vegetation to burning, spraying, and chaining of gambel oak rangeland. Colorado Division of Wildlife, Technical Publication Number 34. 47pp.

Current annual herbage production and elk, mule deer, and cattle use were measured 1 year before and 2, 5 (6 years for cattle), and 10 years after treatment of 8 replicated 24-ha units in the gambel oak (*Quercus gambellii*) vegetation type near Collbran, Colorado. Treatments were: 2 burned units, 2 units sprayed with 2,4,5-TP herbicide, and 2 chained units. Two control units were included. Responses of 92 forbs, 19 grasses, and 16 shrubs were documented at 2,5 and 10 years [post-treatment]. Some plants on burned and chained units, compared with plants on control and sprayed units, showed increased levels of total cell contents, soluble carbohydrates, copper, and zinc. Those differences were observed during the 2nd summer and 3rd winter, but not during the 5th summer after treatment. Elk showed preference for burns after 2,5, and 10 years. Elk use of sprayed and chained units declined after 2 years. Compared to burns, chained units ranked 2nd, and sprayed units 3rd in relative elk preference after 5 years; but elk showed nearly equal preference for sprayed and chained units after 10 years. Deer showed no preference for any treatement after 2 years, but began to show a weak preference pattern for sprayed units after 5 and 10 years. ... (Author's abstract)

Citation Number 194
Ladino, A. G., and J. E. Gates. 1981. Responses of animals to transmission-line corridor management practices. Pp.53.1-53.10 *in* R.E. Tillman, ed. Proceedings of the Second Symposium, Environmental Concerns in Rights-of-Way Management, Mississippi State University.

Animal activity patterns were evaluated within and bordering a 138 kV transmission-line corridor in western Maryland. Two study sites were selected based on differences in management of corridor vegetations. One site was maintained in grasses and forbs by annual mowing, while the other site was kept in shrubs and small trees by spraying with herbicides [Tordon]. Number of crossings per day by animal species in the corridor, the corridor-forest edge, and the adjacent forest habitats at each study site were recorded using a sand-tracking technique from May through November 1978. Results indicated significant differences in activity patterns of certain animals in each habitat type within and between study sites. Particular animals also showed definite seasonal activity patterns.
(Authors' abstract)

Citation Number 195
Landes, R. K. 1976. Herbicides for wildlife habitat manipulation. Pp. 113-127 *in* W.H. Byrnes and H.A. Holt, eds. Herbicides in Forestry. Proceedings of the J.S. Wright Forestry Conference, Purdue University, West Lafayette, Indiana.

Objectives of this paper are to explain why herbicides have been and are being used in wildlife habitat manipulation, review some herbicide uses, and consider alternative methods of habitat manipulation. ... Use of herbicides is one way to manipulate cover diversity. Several reported uses of herbicides in wildlife management including aerial, ground, basal, cut stump, and granular treatments on land and wetlands, are reviewed. ... It seems apparent that herbicide use is a valuable tool for several types of cover management and that there are few, if any, alternatives to accomplish certain objectives in some situations. ... [Herbicides listed include 2,4-D, 2,4,5-T, dalapon, TCA, amitrole, picloram, dicamba, simazine, silvex, bladex, atrazine, and endothall.] (Author's summary)

Citation Number 196

Lautenschlager, R. A. 1986. Forestry, herbicides, and wildlife. Pp. 299-308 *in* J. A. Bissonette, ed. Is good forestry good wildlife management? Maine Agricultural Experiment Station Miscellaneous Publication 689.

At present application rates, herbicide conifer release in the northeast probably affects wildlife populations little. However, if herbicide conifer release increases greatly, it will: reduce the ability of treated areas to support moose (*Alces alces*) and small mammal populations for a short period following treatment; at most cause a short term reduction of deer (*Odocoileus virginianus*) and hare (*Lepus americanus*) populations, which are more likely to benefit within a few years after application; and benefit warblers and associated bird species normally found in the spruce/fir (*Picea* spp./*Abies balsamea*) forest. Although herbicide conifer release could benefit a variety of forest wildlife, forestry herbicides have developed an unjustified negative reputation. ... (Author's abstract)

Citation Number 197

Lautenschlager, R. A. 1991. Response of wildlife in northern ecosystems to conifer release with herbicides. University of Maine, College of Forest Resources, Maine Agricultural Experiment Station, CFRU Information Report 26. 12pp.

[The author reviews 62 papers that examine the effect of herbicide and/or disturbance-related habitat changes on ecosystem processes. Twenty-five of those papers examined the effect of herbicides on wildlife in northern forest ecosystems. Those papers provide the current available information on the effects of herbicides on songbirds, small mammals, snowshoe hare, moose, and deer in northern coniferous forests.] (DLH abstract)

Citation Number 198

Lautenschlager, R. A. 1992. Effects of conifer release with herbicides on moose: browse production, habitat use, and residues in meat. Alces 28:215-222.

Six studies, 5 in spruce plantations and 1 in a naturally regenerated spruce-fir stand, have examined the effects of conifer release with herbicides on moose browse production and habitat use. Both were reduced in plantations and naturally regenerated spruce-fir stands for up to 4 growing seasons after treatment. Only 1 study, in a naturally regenerated stand, examined long-term effects, and there forage production on all treated areas exceeded production on controls 8 growing seasons after treatment. ... herbicides were not found in the flesh of game animals (moose, deer, hare) taken from within or near areas released with glyphosate. (Author's abstract)

Citation Number 199

Lautenschlager, R. A. 1993. Response of wildlife to forest herbicide applications in northern coniferous ecosystems. Canadian Journal of Forest Research 23:2286-2299.

Reviewed studies of the effects of forest herbicide applications on wildlife often lack replication, pretreatment information, and (or) were conducted for only one or two growing seasons after treatment. Because of these problems, ... [and] ... the use of dissimilar sampling techniques, study conclusions have sometimes been contradictory. A review of eight studies of the effects of herbicide treatments on northern songbird populations in regenerating clearcuts indicates total sonbird populations are seldom reduced during the growing season after treatment. Densities of species that use early successional brushy, deciduous cover are sometimes reduced, while densities of species which commonly use more open areas, sometimes increase. A review of 14 studies of the effects of herbicide treatments on small mammals indicates like songbirds, small mammal responses are species specific. ... Fourteen relevant studies examined the effects of conifer release treatments on moose and deer foods and habitat use. Conifer release treatments reduce the availability of moose browse for as long as four growing seasons after treatment. The degree of reduction during the

growing season after treatment varies with the herbicide and rate used. Deer use of treated areas remains unchanged or increases during the first growing season after treatment. Eight years after treating a naturally regenerated spruce-fir stand browse was three to seven times more abundant on treated than on control plots ... Forage quality ... of crop trees increased one growing season after the soil-active herbicide simazine was applied to control competition around outplanted 3-year-old balsam fir seedlings. (Author's abstract)

Citation Number 200

Lautenschlager, R. A. 1993. Effects of conifer release with herbicides on wildlife (A review with an emphasis on Ontario's forests). Ontario Ministry of Natural Resources, Ontario Forest Research Institute, Sault Ste. Marie, Ontario, Forest Research Information Paper Number 111. 23pp.

This paper reviews studies that have examined the effects of forest herbicide treatments on wildlife in Ontario and similar norther coniferous ecosystems. Since most of the research has been short-term, valid generalizations about the effects of conifer release with herbicides on specific wildlife species and/or groups (except moose) must be limited to 1 or 2 growing seasons after treatment. Moose browse and browse use reductions following conifer release with herbicides may last up to 4 years. However, early reductions in browse availability commonly found in treated areas may be offset by later additions [up to 8 years post-treatment]. [Limited data] suggests that if herbicide treatments reduce other (non-moose) local wildlife populations, those reductions likely last for only 1 or 2 years after treatment. Howerver, more long term research is needed. ... (Author's abstract)

Citation Number 201

Lautenschlager, R. A., C. Hollstedt, and F. W. Bell. 1995. Effects of herbicide, manual, and annual release of young jack pine on vegetation and small mammals in northwestern Ontario. Pp. 149-151 *in* R. E. Gaskin and J. A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

This study documents the effects of standard aerial herbicide (glyphosate) application, annually repeated herbicide applications and a proposed alternative (brushsaw cutting) for conifer release in a jack pine system in northwestern Ontario. Treatments increased survival and growth of planted pine, but their effects on resident small mammals were species specific. Redback voles and eastern chipmunks were reduced, deer mice were unaffected, and least chipmunks increased following herbicide treatments. Manual brushsaw cutting did not reduce small mammal populations less, or for a shorter period, than traditional aerial release treatments. (Authors' summary)

Citation Number 202

Lautenschlager, R. A., T. P. Sullivan, and R. G. Wagner. 1995. Using herbicides for wildlife management in northern ecosystems. Pp. 152-154 *in* R. E. Gaskin and J. A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

[The authors examine the effects of herbicides on wildlife habitat (based on the literature and their experience) in northern ecosystems and suggest specific vegetation management approaches using herbicides that have or could improve habitat for a variety of wildlife species and groups]. By choosing appropriately (active ingredient, time, application technique), herbicides can: (1) reduce densities of invading non-native plants (restoring native populations and associated wildlife); (2) create snags, dead and down woody material, and "drumming logs" in early or later successional stands (providing "old growth" characteristics); (3) create small, intermediate, or large early successional openings within older vegetation types; (4) change shrub dominated areas to earlier successional grassy, or herb/grass dominated communities; (5) favor male aspen

clones; (6) release patches or expanses of conifers; and (7) keep woody and herbaceous "browse" within reach of browsing animals. (Authors' summary)

Citation Number 203
Lawrence, W. H. 1967. Effects of vegetation management on wildlife. Pp. 88-93 *in* M.A. Newton, ed. Herbicides and Vegetation Management in Forests, Range and Noncrop Lands. Oregon State University, Corvallis.

[Three examples of wildlife-herbicide interactions are discussed: 1) maintenance of suitable wildlife habitat, 2) conversion of an existing vegetation pattern to another vegetative type, and 3) ecological control of animal numbers through habitat manipulation. Examples from the literature are provided.] (KVM abstract)

Citation Number 204
Lawson, B. A., and J. E. Gates. 1981. Habitat-niche discrimination of passerines along a transmission-line corridor. Pp. 67.1-67.8 *in* R.E. Tillman, ed. Proceedings of the Second Symposium, Environmental Concerns in Rights-of-Way Management, Mississippi State University.

Habitat variables important in discriminating among eight species of passerines nesting along a 138 kV transmission-line corridor in western Maryland were sought. ... Corridor maintenance by selective applications of herbicide was found to create more habitat diversity, hence greater bird species diversity, than maintenance by annual mowing. (Authors' abstract)

Citation Number 205
Lee, D. V. 1971. The effects of herbicidal control on wildlife habitat in Louisiana. M.S. Thesis, Louisiana State University, Baton Rouge. 73pp.

... Data collected from one to seven years after application of 2,4,5-trichlorophenoxyacetic acid (2,4,5-T) on nine study areas in Louisiana indicate no detrimental effects on understory vegetation of importance to wildlife. In most instances, selected browse species were not significantly increased in number; however, neither were these plants significantly reduced in number. White-tailed deer demonstrated no preference between treated and non-treated browse plants, although they did show preference for different species. Very little difference was observed between aerial and mist blower applications on total vegetation and preferred browse species two years after application. ... (Author's abstract)

Citation Number 206
Leonard, J. W., and S. A. Cain. 1961. The role of herbicides in wildlife management. Pp. 1422-1426 *in* Recent Advances in Botany, University of Toronto Press.

[The use of herbicides in game management in the future is likely to depend on two considerations: (1) cost is often too high; (2) the game manager is still unable to predict with desirable confidence just what results he may get. Specific aspects of game and fishery management in which herbicides have been used and in which results offer promise are discussed.] (KVM abstract)

Citation Number 207
Lewis, J. B., and R. L. Dunkeson. 1956. Use of herbicides for improving Ozark wild turkey and deer range. Proceedings of the North Central Weed Control Conference 13:28.

Wild turkey restoration is a major problem confronting Missouri game biologists. ... On non-commercial sites unwanted woody vegetation has been killed by a combination of cutting and girdling, frilling and basal spray; 2,4,5-T is used according to manufacturers' recommendations, in frills and basal

spray. Hickories, elms, ash, and poor quality oaks are killed. Food-producers, such as dogwood, gum, serviceberry, and grape, and healthy acorn producers are released for greater fruit production. (Authors' abstract)

Citation Number 208
Linde, A. F. 1985. Vegetation management in water impoundments: alternatives and supplements to water-level control. Proceedings, Water impoundments for wildlife: A habitat management workshop. United States Department of Agriculture, Forest Service, General Technical Report NC-100.

[Techniques useful for vegetation management in water impoundments discussed include controlled burning, crushing and mowing, herbicides, wetland farming, tillage farming, and mudflat farming. Herbicides listed include 2,4-D, 2,4,5-T, Tordon, Simazine, and Atrazine.] (KVM abstract)

Citation Number 209
Lindzey, J. S. 1960. Food and cover modification. Pp. 40-73 *in* R.E. McDermott and W.R. Byrnes, eds. Herbicides and Their Use in Forestry. School of Forestry, Pennsylvania State University.

[There are several ways in which the use of herbicides can be expected to supplement other methods for the management of habitat for wildlife. Several examples are provided from the literature that illustrate the various uses of herbicides in wildlife habitat management. Herbicides should not be considered a cure-all, but a tool to be used at the right time and place and in the right way.] (KVM abstract)

Citation Number 210
Lochmiller, R. L., J. F. Boggs, S. T. McMurry, D. M. Leslie, Jr., and D. M. Engle. 1991. Response of cottontail rabbit populations to herbicide and fire applications on cross timbers rangeland. Journal of Range Management 44:150-155.

[The authors evaluated the impact of brush management on cottontail rabbit (*Sylvilagus floridanus*) populations in the cross timbers rangeland of Oklahoma. Results indicate that triclopyr and tebuthiuron herbicide applications used in combination with and without annual prescribed burning have no adverse impacts on resident rabbit populations. Line transect censuses, fecal pellet counts, and habitat preference evaluations suggested that treated areas supported higher densities of rabbits and provided more preferred habitat types than control areas. Line transect censuses also suggested that prescribed burning had a positive impact on density of rabbit populations. Habitat preference evaluations suggested the pasture treated with tebuthiuron provided more favorable habitat for rabbits than the pasture treated with triclopyr. Applications of tebuthiuron and triclopyr, either with or without prescribed burning, provide a useful management option for increasing the diversity of habitats and increasing preferred habitat types of cottontail rabbits.] (DLH abstract)

Citation Number 211
Lyon, L. J., and W. F. Mueggler. 1968. Herbicide treatment on north Idaho browse evaluated six years later. Journal of Wildlife Management 32:538-541.

Five species of north Idaho browse plants that were treated in 1960 were reexamined to evaluate long-term response to herbicides [2,4-D and 2,4,5-T. They] found some lag in plant mortality of undesirable species coupled with generally poor persistence of sprouting and relatively quick recovery from crown dieback in the desirable species. Redstem ceanothus (*Ceanothus sanguineus*), the most desirable browse plant tested, was killed by all treatments. (Authors' abstract)

Citation Number 212

Mackinnon, D. S., and B. Freedman. 1993. Effects of silvicultural use of the herbicide glyphosate on breeding birds of regenerating clearcuts in Nova Scotia, Canada. Journal of Applied Ecology 30:395-406.

The effects of habitat changes caused by the spraying of herbicides [glyphosate] on the breeding birds of regenerated cleacut woodland were studied for one pre-spray and four post-spray years. Between the pre-spray and first post-spray years, the densities of most common breeding species decreased on all treatment plots, including the reference. In the second post-spray year, bird abundance on the reference plot increased to about the pre-spray condition, while on spray plots abundance stayed similar to the first post-spray year, and was smaller than the pre-spray population. The two most-abundant species, white-throated sparrow and common yellowthroat, decreased on all spray plots up to the second post-spray year, and then substantially recovered by the fourth post-spray year. Song sparrow and Lincoln's sparrow declined on the reference plot among the four study years, while on the spray plots these species were most abundant in the second and fourth post-spray years. Changes in avifauna [relative to the reference plot] were inhibited by herbicide treatment of spray plots until the fourth post-spray year. Overall, the data presented suggests that there are relatively small and short-term effects of the silvicultural use of glyphosate on the prominent bird species of regenerating clearcuts. (Authors' summary)

Citation Number 213

MacMullan, R. A., and E. M. Harger. 1955. Control of undesirable plants in waterfowl projects. Proceedings of the North Central Weed Control Conference 12:58-59.

[To determine the best methods of creating openings in dense sedge (*Carex* and *Scirpus*) or leatherleaf (*Chamaedaphne calyculata*), the Michigan Department of Conservation conducted a series of experiments involving plowing and different chemical treatments. Ammate at a concentration of 0.25 lbs/gal @ 250 gal/ac appears to provide a good kill of leatherleaf, although smaller concentrations may be effective. Dalapon at 10 lbs/ac applied as a foliage drench yielded 100% kill of sedge. Possibly smaller amounts would be effective.] (KVM abstract)

Citation Number 214

Malecki, R. A., and T. J. Rawinski. 1985. New methods for controlling purple loosestrife (*Lythrum alicaria*). New York Fish and Game Journal 32:9-19.

New methods for controlling purple loosestrife were investigated ... in central New York during 1978-1980. Neither late-summer cutting nor partial flooding had more than a seasonal impact on the plant, but cutting followed by flooding in the same year may result in significant stress. ... The herbicide glyphosate was extremely effective (100 percent control) on test plots when applied at a rate of 1.7 kg/ha in mid-August. Viability of seeds from treated plants was sufficient for concern. Sowing Japanese millet on exposed moist-soil sites at a rate of 34 kg/ha following a drawdown resulted in successful control of loosestrife on those areas as well as production of a desirable waterfowl food. (Authors' abstract)

Citation Number 215

Malefyt, J. J. de Wall. 1982. Effect of vegetation management on bird populations along electric transmission rights-of-way. Pp. 570-580 *in* A. F. Crabtree, ed. Proceedings of the Third Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

[The effects of right-of-way vegetation management techniques on] bird species diversity (BSD) and density values were determined from transect-strips in eastern New York. BSD and density were highest on ROWs where trees received cut-and-stump or basal treatments with herbicides. BSD and density were consistently found to be lower on ROWs brush-mowed the year previous to census taking, and similarly low densities were found years later on ROWs broadcast sprayed with herbicides. The effect of mowing on

mixed-woody vegetation on ROW bird populations is very short-termed when compared to ROWs aerially treated with herbicides. The effects of various ROW vegetation management techniques on nesting and foraging guilds were also analyzed. Low and middle foliage feeders were more abundant on ROWs which received cut-and-stump and basal treatments. ... (Author's abstract)

Citation Number 216

Malefyt, J. J. de Wall. 1985. Effects of vegetation management on breeding bird populations along electric transmission rights of way. New York Fish and Game Journal 32:197-210.

Approximately 80,000 acres of vegetation are managed by the major electric utilities on their electric transmission rights of way in New York. A variety of methods are used, but their effects on bird populations are relatively unknown. Data concerning the principal methods were recorded from strip transects on 14 rights of way in western and eastern New York. Bird species diversity and abundance were highest where selective treatment with herbicides had been used to eliminate undesirable vegetation, whereas they were consistently lower on sites that had been mowed or aerially sprayed. Selective treatment especially favored the low- and middle-foliage feeders and shrub-nesting species. However, ground feeders were common on the mowed sites. The costs of these methods are discussed. (Author's abstract)

Citation Number 217

Malefyt, J. J. de Wall. 1987. Effects of herbicide spraying on breeding songbird habitat along electric transmission rights-of-way. Pp. 28-33 *in* W. R. Byrnes and H. A. Holt, eds. Proceedings of the Fourth National Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

Songbird density and indices of species richness and similarity were examined before and after application of herbicides by basal, stump, foliar, and aerial methods. Significant decreases in songbird densities were observed on aerially sprayed ROW and on some foliar and stump treated ROW. The greatest decrease (64%) occurred on an aerially sprayed ROW where songbird density decreased from 3.6 to 1.3 birds/ha after treatment. The smallest changes in density (0 and 6%) were observed on basally treated ROW. The species similarity index showed that songbird species following basal and stump treatments were more similar to each other than species on aerial and foliar treated ROW, with the latter two treatments also being similar to each other. ... Total breeding bird density was positively correlated with shrub cover and to a lesser extent with tree cover. Songbird density was negatively correlated with herbaceous plant cover. These results show that breeding songbird habitat on transmission ROW can be significantly affected by commonly-used vegetation maintenance techniques. This is especially true where sites have a moderate to heavy cover of undesirable trees and where extensive areas are defoliated by foliar and aerially sprayed herbicides. [Herbicides used include 2,4-D, picloram and triclopyr.] (Author's abstract)

Citation Number 218

Martin, A. C. 1953. Improving duck marshes by weed control. United States Department of the Interior, Fish and Wildlife Service, Circular 19. 49pp.

[Through the control of undesirable weeds in duck marshes, desirable duck-food plants can be given new opportunity to succeed in many localities. Methods of control, including herbicides (2,4-D) are presented for numerous undesirable marsh weeds and woody plants including *Typha* spp., *Phragmites communis*, *Zizaniopsis miliacea*, *Panicum hemitomon*, *Eichhornia crassipes*, *Juncus roemerianus*, *Alternanthera philoxeroides*, *Nuphar* spp., *Nymphaea* spp., *Nelumbo pentapetala*, *Hibiscus* spp., *Trapa natans*, *Salix* spp., *Alnus* spp., *Tamarix gallica*, and *Cephalanthus occidentalis*.] (KVM abstract)

Citation Number 219

Martin, N. S. 1965. Effects of chemical control of sagebrush on the occurrence of sage grouse in southwestern Montana. M.S. Thesis, Montana State College, Bozeman. 38pp.

A study was conducted ... in Southwestern Montana [on] 1,710 acres [that] had been sprayed in 1961 with 2,4-D to control sagebrush [to] obtain quantitative data on effects of chemical control of sagebrush on a sage grouse population. ... The similarity of the vegetation composition at sage grouse locations and in the unsprayed strips led to the conclusion that the differences in numbers of sage grouse observed in sprayed and unsprayed strips were related to vegetation composition. ... high frequency food plants were more abundant in unsprayed than in sprayed strips, which strengthened the conclusion that differences in numbers of sage grouse observed in unsprayed and sprayed strips were related to vegetation composition. (Author's abstract)

Citation Number 220

Martin, N. S. 1970. Sagebrush control related to habitat and sage grouse occurrence. Journal of Wildlife Management 34:313-320.

The effects of chemical manipulation of big sagebrush (*Artemisia tridentata*) on sage grouse (*Centrocercus urophasianus*) were studied in Montana during the summers of 1962 through 1964. The principal study was conducted on 1,900 acres, of which, 1,710 had been strip-sprayed in 1961 with 2,4-D. ... The similarity of vegetation at grouse locations and in the unsprayed strip led to the conclusion that differences in numbers of sage grouse observed in sprayed and unsprayed strips were related to vegetation composition. ... Favored food plants were more abundant in the unsprayed than in the sprayed strip, supporting the conclusion that differences in numbers of sage grouse observed in unsprayed and sprayed strips were related to vegetation composition. (Author's abstract)

Citation Number 221

Martin, R. P. 1965. Effects of the herbicide, 2,4,5-T, on breeding bird populations. Proceedings of the Oklahoma Academy of Science 46:235-237.

Total populations of nesting birds on 20-acre study areas [in Creek County, Oklahoma] dominated by postoak-blackjack forest were 17 species and 140 breeding males per 100 acres in the control area compared to 18 species and 205 breeding males in the [2,4,5-T] sprayed area. [Surveys were conducted 3 years after spraying. The sprayed area provided a suitable habitat for significantly more pairs of a number of species.] Based on one season's observations the treatment with herbicides had no marked adverse effect upon any nesting species of birds and actually improved habitat for a few species. (Author's summary)

Citation Number 222

May, T. A., D. E. May, and M. L. McCormack, Jr. 1982. Plant response to herbicides in clear cut conifer strips. Proceedings of the Northeast Weed Science Society 36:205-208.

Plant species composition and abundance were measured in regenerating (4-5 years) clearcut strips in Maine spruce-fir forests prior to, 1 year after, and 3 years after application of varying rates of glyphosate in combination with 2,4-D, and triclopyr. Changes in plant species indices were used to categorize plant response to the herbicides used. The implications of these changes to wildlife use of herbicide-modified clearcut strips are discussed. (Authors' abstract)

Citation Number 223
Mayer, T. D. 1976. An evaluation of chemically-sprayed electric transmission line rights-of-way for actual and potential wildlife use. Pp. 287-294 *in* R.E. Tillman, ed. Proceedings of the First National Symposium, Environmental Concerns in Rights-of-way Management, Mississippi State University.

A wildlife inventory, emphasizing three major game species in each state, was conducted on chemically-maintained rights-of-way in New Hampshire, Georgia, and West Virginia. Plant cover types were evaluated and mapped on 27 plots in the three states. Results indicate that rights-of-way are comparable or superior in wildlife foods to adjacent unsprayed plots. Chemically treated rights-of-way did show greater wildlife use than adjacent old-field habitats. (Author's abstract)

Citation Number 224
McArthur, L. B. 1980. The impact of various forest management practices on passerine community structure. Ph.D. Dissertation, West Virginia University, Morgantown. 129pp.

Six watersheds that had been treated differently were studied in the Fernow Experimental Forest, near Parsons, Tucker Co., West Virginia. Bird communities in recent clearcut areas were sampled during the breeding season for 3 yrs using belt transects through each watershed. ... Herbicide use retards development of a clearcut into forest and consequently causes the bird community to remain as an early successional stage community. ... (Author's abstract)

Citation Number 225
McCaffery, K. R., and W. A. Creed. 1969. Significance of forest openings to deer in northern Wisconsin. Wisconsin Department of National Resources, Technical Bulletin 44. 104pp.

[The role openings play in the summer range ecology of deer in areas where loamy soils predominate is presented. Sections include the influence that forest types and openings have on deer distribution and density, characteristics and deer use of forest openings, and recommendations for designing and implementing openings management programs. The latter section contains recommendations for using herbicides, primarily Tordon, in opening maintenance.] (KVM abstract)

Citation Number 226
McCaffery, K. R., F. L. Johnson, and L. D. Martoglio. 1974. Maintaining wildlife openings with pellets containing picloram. Down-To-Earth 30:1-6.

Pellets containing picloram, the active ingredient in TORDON 10K Pellets herbicide, were used to selectively control unwanted woody vegetation in wildlife openings. The pellets were more convenient, economical, and effective than mechanical and liquid herbicide methods used previously. Ease of picloram application has greatly increased the scope of opening maintenance programs in Wisconsin. Broadcast application of picloram for wildlife purposes is not recommended because of the effects on desirable herbs and shrubs. (Authors' abstract)

Citation Number 227
McCaffery, K. R., L. D. Martoglio, and F. L. Johnson. 1974. Maintaining wildlife openings with picloram pellets. Wildlife Society Bulletin 2:40-45.

Picloram pellets (Tordon 10K) were used to selectively control unwanted woody vegetation in wildlife openings. The pellets were more convenient, economical, and effective than mechanical and liquid herbicide methods used previously. Ease of picloram application has greatly increased the scope of opening maintenance programs in Wisconsin. Broadcast application of picloram for wildlife purposes is not recommended because of the effect on desirable herbs and shrubs. (Authors' abstract)

Citation Number 228
McComb, W. C., and R. L. Rumsey. 1981. Habitat characteristics of forest clearings created by picloram herbicides and clearcutting. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 35:174-184.

Twenty-six habitat characteristics were quantified on untreated, clearcut, and picloram-treated plots on north-facing, south-facing, and ridgetop sites in eastern Kentucky. ... Herbicide plots were intermediate between untreated and clearcut plots in 15 characteristics. Hard and some soft mast species and browse species were adversely affected by herbicide application. ... Snag abundance and diameter were greatest on rigdetop and south-facing plots receiving 68 kg/ha of TORDON 10K. An application rate of 23 kg/ha of TORDON 10K on south-facing slopes provided 23 habitat characteristics which were equal to or better than untreated plots. (Authors' abstract)

Citation Number 229
McComb, W. C., and R. L. Rumsey. 1982. Response of small mammals to forest clearings created by herbicides in the central Appalachians. Brimleyana 8:121-134.

Removal trapping was used to determine relative abundance of 6 small mammals species on uncut, clearcut, and herbicide-treated plots on ridgetop, southfacing and northfacing sites in eastern Kentucky. Four rates of picloram-based herbicides were tested. Twenty-nine microsite characteristics were measured at each trap station to determine variables important to capture of each species. ... Relative abundance of *Sorex fumeus*, *Peromyscus leucopus*, *Ochrotomys nuttalli*, and *Microtus pinetorum* was higher on at least one of the treatments than on untreated plots. ... Relative abundances of *Blarina brevicauda* and *Tamias striatus* were unaffected by treatment. ... Changes in structure of overstory and understory, as well as in snag, log, stump and/or rock characteristics, accounted for differential responses of four species to treatments. ... (Authors' abstract)

Citation Number 230
McComb, W. C., and R. L. Rumsey. 1983. Bird density and habitat use in forest openings created by herbicides and clearcutting in the central Appalachians. Brimleyana 9:83-95.

Winter and breeding bird communities were sampled on clearcuts, on plots receiving four rates of picloram herbicide application, and on untreated plots. Four-year-old picloram treated plots did not increase bird species diversity, but did increase bird density over untreated plots. Positive response of some bird species to treatment was due to creation of an edge. ... A variety of picloram herbicide treatments (27-68 kg/ha) and clearcutting in small (0.5-1.0 ha) blocks, on both south-facing and north-facing slopes, is recommended to increase bird density and provide more diverse habitat than exists in undisturbed forests. (Authors' abstract)

Citation Number 231
McComb, W. C., and R. L. Rumsey. 1983. Characteristics and cavity-nesting bird use of picloram-created snags in the central Appalachians. Southern Journal of Applied Forestry 7:34-37.

A soil-applied herbicide rate of 40 lb/acre TORDON 10K created snags (dead trees) and/or habitat characteristics desirable for foraging and nesting cavity-nesting birds in eastern Kentucky. Integration of picloram pellet application into TSI programs would allow stand quality improvement and a sustained supply of potential feeding and nesting sites for cavity-dependent birds. (Authors' abstract)

Citation Number 232
McComb, W. C., and G. A. Hurst. 1987. Herbicide and wildlife in southern forests. Pp. 28-39 *in* J.G. Dickson and O.E. Maughan, eds. Managing Southern Forests for Wildlife and Fish. United States Department of Agriculture, Forest Service, General Technical Report S0-65.

A review was conducted of the literature on the direct and indirect effects of herbicide application on forest wildlife. ... Herbicide application alters habitat composition and structure thereby resulting in differential response to herbicide-treated stands by terrestrial vertebrates. Application of herbicides in most southern forest situations may result in short-term changes in the abundance of some terrestrial vertebrates. Herbicide use in mature forest for TSI will promote canopy gaps and understory biomass production, while use in young clearcuts will temporarily reduce understory biomass. Published data describing direct effects of herbicide application on wildlife reproduction and survival and on herpetofaunal response to habitat changes are lacking. [This paper also can be found in the Proceedings of the Society of American Foresters National Convention 1986, 160-168.] (Authors' abstract)

Citation Number 233
McCormack, M. L., Jr. 1985. Chemical weed control in northeast forests. J. S. Wright Forestry Conference, Purdue University, West Lafayette, Indiana. Pp. 108-115.

[The use of various herbicidal treatments to control a number of weed species associated with forestry site preparation in the Northeast is discussed. Some wildlife implications are discussed. Herbicides listed include atrazine, 2,4-D, MSMA, picloram, triclopyr, glyphosate, fosamine, and hexazinone.] (KVM abstract)

Citation Number 234
McGilvrey, F. B. 1967. Effects of elimination of alligator weed on certain aquatic plants and the values of these plants as waterfowl foods. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners18:73-79.

The effects of elimination of alligatorweed (*Alternanthera philoxeroides*) by granular silvex on the abundance of 12 species of aquatic plants were studied on the Santee National Wildlife Refuge, Lake Marion, South Carolina, from 1961 to 1964. Three hundred and sixty duck stomachs collected from hunters during the 1961 hunting season were examined to determine the importance of these 12 species as waterfowl food. (Author's abstract)

Citation Number 235
McKee, B. 1972. Winter deer food production and rabbit utilization of various site preparation treatments. Proceedings of the Southeastern Association of Game and Fish Commissioners 26:218-221.

The effects of several site preparation treatments [including mistblowing and injecting herbicides] on winter deer food yield and rabbit utilization were studied in one to four year old loblolly pine plantations in Kemper County, Mississippi. Winter deer food availability ranged from 5 - 20 times greater on clearcut and site prepared areas than on the uncut forest. The bedded treatment produced the highest amount of winter food. However, rabbit utilization was much lower on the bedded areas than on the sheared and chopped treatments. (Author's abstract)

Citation Number 236
McMillan, L. M., J. F. Connor, H. R. Timmermann, J. G. McNicol, and C. S. Krishka. 1990. Small mammal and lesser vegetation response to glyphosate tending in north central Ontario. Ontario Ministry of Natural Resources, Northwestern Ontario Forest Technology Development Unit, Thunder Bay. Technical Report 57. 28pp.

Small mammal response to herbicide-induced habitat changes was studied in four northcentral Ontario clearcuts. Eight hundred and sixty-seven small mammals representing eight species were sampled in 3,600 trap nights over 3 years. Deer mice (*Peromyscus maniculatus*) accounted for 55% of all captures followed by least chipmunks (*Eutamias minimus*) 16%, red-backed voles (*Clethrionomys gapperi*) 15%, three species of shrews 10%, and meadow voles (*Microtus pennsylvanicus*) and jumping mice (*Zapus hudsonius*) 4%, collectively. More specimens were captured on glyphosate-treated clearcuts, one, two, and three years post-treatment than on untreated controls (475 versus 392). When plots located in missed strips and residual vegetation within sprayed clearcuts were removed from the dataset, the treatment effects appeared minimal (404 treated versus 387 control). Deer mice increased two and three years post-spray on the treated plots, whereas red-backed voles tended to decrease one, two, and tree years post-spray. It is postulated these variations were related to changes in vegetation due to herbicide treaatment. Seventy-one species/genera of woody and herbaceous vegetation were assessed over three years of the study. Species richness was variable, but there were no significant changes over time. The relationship between small mammals and vegetation were discussed. (Authors' abstract)

Citation Number 237
McMurry, S. T., D. M. Engle, R. L. Lochmiller, and D. M. Leslie, Jr. 1988. Small mammal community responses to brush management in Oklahoma Cross Timbers. Annual Meeting of the American Society of Mammalogists 68:178.

Influence of brush management on small mammal communities inhabiting post oak (*Quercus stellata*) - blackjack oak (*Q. marilandica*) Cross Timbers vegetation type were assessed during summer (June 1986) and winter (Dec. 1986) in Payne Co, Oklahoma. Ten 32.5 ha pastures, representing 2 replications per brush treatment (tebuthiuron and triclopyr herbicides applied with and without annual prescribed burning, and controls), were sampled each season by removal trapping. ... Highest biomass in summer occurred on triclopyr sites and in winter on tebuthiuron sites. Relative population diversity ranged from 0.9 to 1.5 in summer and 0.9 to 1.8 in winter, with highest diversities on tebuthiuron + fire and triclopyr + fire for both seasons. ... (Authors' abstract)

Citation Number 238
McMurry, S. T. 1989. Effects of habitat modification with herbicide and prescribed burning on small mammal populations inhabiting cross timbers rangeland in Oklahoma. M.S. Thesis, Oklahoma State University, Stillwater. 117pp.

[The author examined the effects of 5 experimental brush treatments (tebuthiuron and triclopyr herbicides, applied with and without annual prescribed burning, and untreated controls) on relative population density, reproduction, and condition of white-footed mice (*Peromyscus leucopus*), cotton rats (*Sigmodon hispidus*), and eastern woodrats (*Neotoma floridana*) in cross timbers rangeland in Oklahoma. Their effects on food habits of eastern woodrats are also examined.] (DLH abstract)

Citation Number 239
McMurry, S. T., R. L. Lochmiller, J. F. Boggs, D. M. Leslie, Jr., and D. M. Engle. 1993. Woodrat population dynamics following modification of resource availability. American Midland Naturalist 129:248-256.

... The influence of four experimental brush treatments [tebuthiuron and triclopyr herbicides applied with and without annual prescribed burning] on relative population density, reproduction and body condition of eastern woodrat (*Neotoma floridana*) populations on Cross Timbers rangeland in Oklahoma [was examined]. ... Untreated reference sites also were evaluated. ... Maximum summer peaks in density were observed each year on triclopyr treatments. Density was similar between populations on tebuthiuron

treatments and reference sites. Reproductive activity of females varied among seasons but not among experimental treatments ... Percentage of reproductively active males ... was less than expected in winter. Mean body weights and condition scores were highest in autumn and spring but were not influenced by experimental treatments. Mean stomach content weight did not differ among seasons or experimental brush treatments. (Authors' abstract)

Citation Number 240

McNease, L. L., and G. A. Hurst. 1991. Preharvest treatment with imazapyr for seed tree regeneration and habitat improvement. Proceedings of the Southern Weed Science Society 44:265.

[Imazapyr was applied by ground equipment (skidder) in August 1989 in a 50-year-old, natural, loblolly pine (*Pinus taeda*) stand in Noxubee County, Mississippi. Approximately 95% of the hardwood stems were killed. The treated area was then seed tree harvest cut and control burned. Selected white-tailed deer (*Odocoileus virginianus*) forage abundance was measured in September 1990. Total deer forage was significantly greater on the treated area than on the control area. Vine, mostly blackberry (*Rubus* spp.), and forb forage were significantly greater on the treated than on the control area, but grass and woody browse were not different. Habitat conditions, e.g. deer forage and forb seed production, will improve greatly on the treated area.] (DLH abstract)

Citation Number 241

McPeek, G. A. 1985. Decay patterns and bird use of snags created with herbicide injections and tree topping. M.S. Thesis, University of Kentucky, Lexington. 115pp.

Herbicide injection and tree topping were used to create snags in a mixed mesophytic forest in southeastern Kentucky. In 1982, 360 trees (6 taxa) in a 20-ha area were injected with TORDON 101R, and half were topped at a height of 8.8 m. ... Topped and intact trees had similar decay characteristics the first 2 years after treatment. Bark-foraging birds utilized large diameter snags more than small diameter snags, and yellow pine snags (*Pinus rigida* and *P. echinata*) more than the other 5 tree species. Winter densities of bark-foraging birds were significantly greater [on the treated area than on the control area]. No nesting or roosting bird cavities were observed in herbicide-created snags the first 2 years. ... (Author's abstract)

Citation Number 242

McPeek, G. A., W. C. McComb, J. J. Moriarty, and G. E. Jacoby. 1987. Bark-foraging bird abundance unaffected by increased snag availability in a mixed mesaphytic forest. Wilson Bulletin 99:253-257.

[The response of bark-foraging birds to increased snag availability created by TORDON 101R injection and topping was studied in Robison Forest, Breathitt County, Kentucky. Trees were treated during summer 1982. Winter and breeding birds were counted in 1981, 1983, 1984, and 1985. Average abundance of winter bark-foraging birds did not increase significantly following treatment on the experimental area relative to the control area. Relative abundance of bark-foragers in the breeding season was not significantly different between the TSI and control area. Increasing snag availability beyond 15 snags per ha may have increased the fitness of bark-foragers by increasing forage efficiency, but it did not result in an increase in bird abundance.] (KVM abstract)

Citation Number 243

Miller, H. A. 1967. A case for wildlife in hardwood control. Forest Farmer 21:5-6.

... game habitat can be protected during stand conversion by (1) treating [spraying] only "poor" hardwood sites, (2) retaining natural "good" hardwood sites where terrain permits, and (3) leaving alternate untreated strips of "poor" hardwood where "good" hardwood sites are absent. These minimum requirements should also be looked upon as insurance against possible wildlife damage to the new plantings. Following

conversion, management of the new pine forests offers excellent opportunities for a coordinated wildlife and timber program. (Author's summary)

Citation Number 244

Miller, K. V., M. D. Whitney, P. B. Bush, and J. W. Taylor. 1989. Wildlife habitat redevelopment following Upper Coastal Plain site preparation. Proceedings of the Southern Weed Science Society 42:303.

Revegetation of a loblolly pine (*Pinus taeda)* plantation following chemical [picloram @ 2.0 lbs ai/ac + fluroxypyr @ 2.0 lbs ai/ac and hexazinone @ 2.5 lbs ai/ac] and mechanical [rollerchop] site preparation was studied [1yr post-treatment] on an Upper Coastal Plain site in Barnwell County, S.C. ... Grasses, primarily *Cynodon dactylon*, *Panicum* spp., and *Andropogon* spp., were the predominant vegetative type on the chemically treated sites. ... Legumes were more abundant on the hexazinone site ... than on the other chemically treated site ... or on the mechanical area. ... Forb and woody vegetation production on the roller-chopped area provided abundant forage for white-tailed deer (*Odocoileus virginianus*). Although total production of forbs and woody vegetation was less on the chemical areas, several preferred forb species were as abundant or more abundant. The hexazinone treated area produced the greatest amount of legumes favored by bobwhite quail (*Colinus virginianus*). The heavy grass cover on the chemically prepared sites likely favored many rodent species and provided summer foraging sites for wild turkey (*Meleagris gallapavo*). ... (Authors' abstract)

Citation Number 245

Miller, K. V., P. B. Bush, J. W. Taylor, and D. G. Neary. 1990. Herbicides and wildlife habitat: an annotated bibliography on the effects of herbicides on wildlife habitat and their uses in habitat management. United States Department of Agriculture, Forest Service, Technical Publication R8-TP 13. 152pp.

This annotated bibliography is a compilation of published reports (1954-1989) on the effects of herbicides on wildlife habitat and their uses in habitat management. The uses of herbicides in timber, range, right-of-way management, and wildlife habitat enhancement are emphasized. This compilation will aid managers in determining the wildlife implications of vegetation management activities on wildlife species and also assist researchers in identifying research needs. Geographically, this bibliography covers the continental United States and Canada. A few pertinent publications from other geographic regions have been included. (extracted from Authors' introduction)

Citation Number 246

Miller, K. V., and J. S. Witt. 1990. Impacts of forestry herbicides on wildlife. Pp. 795-800 *in* S. S. Coleman and D. G. Neary, eds. Proceedings of the Sixth Biennial Southern Silvicultural Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SE-70.

Concern over the widespread use of herbicides arises from two factors: potential direct toxicity to wildlife and indirect effects on wildlife habitat. From the results of our studies and other published literature, it is apparent that wildlife habitat is not adversely affected by herbicidal site preparation, except perhaps in the first growing season. Herbicide use at times may be superior to other vegetation management methods in terms of their effects on wildlife. However, the vastly differing plant communities that develop following the use of different chemicals necessitates additional study of their impacts on wild species. (Authors' abstract)

Citation Number 247

Miller, K. V., P. B. Bush, J. W. Taylor, and D. G. Neary. 1990. Herbicide and wildlife habitat: a review of 35 years of research. Proceedings of the Southern Weed Science Society 43:202.

A detailed review of literature on the effects of herbicides on wildlife habitat and their uses in habitat management (1954 to 1989) was conducted [see Miller et al. 1990 above]. ... This review emphasizes that

there is little information on the indirect effects of herbicides on wildlife species, especially endemic and migratory threatened and endangered species. ... The few studies conducted to date indicate that herbicidal vegetation management may not adversely affect wildlife habitat to a large extent and in many cases may actually improve conditions for wildlife. However, the selectivity of many newer herbicides necessitates additional studies to determine and analyze important changes in plant succession which may affect key wildlife species. This information is necessary to guide forestry use of herbicides, and determine the real environmental impacts of alternative vegetation management practices. (Authors' abstract)

Citation Number 248

Miller, K. V., and B. R. Chapman. 1995. Responses of vegetation, birds, and small mammals to chemical and mechanical site preparation. Pp. 146-148 *in* R. E. Gaskin and J. A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

Two studies were conducted in the Upper Coastal Plain physiographic province of the southeastern United States [Georgia and South Carolina] to evaluate the response of wildlife habitat and wildlife communities to various site preparation treatments. Treatments included a mechanical (V-blade and windrow) and 3 chemical treatments (hexazinone, imazapyr, and picloram+triclopyr). Although differences occurred in the redeveloping plant communities [emphasis was placed on plants important as forage for northern bobwhite (*Colinus virginianus*) and white-tailed deer (*Odocoileus virginianus*)], and [in the abundance and diversity of the] associated vertebrate communities [small mammals and birds], these differences were short-lived. Treatment related differences were no longer evident at 5 years post-treatment. (Authors' summary)

Citation Number 249

Morgan, R. H., and M. L. McCormack, Jr. 1973. Simazine enhances balsam fir growth but contributes to deer damage. Tree Planters Notes 24:11-13.

This study indicates that growth benefits for young balsam firs may perhaps be attained more economically by using the herbicide simazine to control plant competition, as compared to a fertilizer and herbicide combination treatment. ... From the standpoint of wildlife habitat management and buffer food production, the cultural practices that make commercial planting susceptible to damage can be used to enhance the food value of noncommercial trees and plants for wildlife. (Authors' summary)

Citation Number 250

Morrison, M. L. 1982. Response of avian communities to herbicide-induced vegetation changes, western Oregon. Ph.D. Thesis, Oregon State University, Corvallis. 85pp.

The relationship between avian community structure and herbicide modification of vegetation were analyzed on early-growth clearcuts in western Oregon that had received phenoxy herbicide [2,4-D, 2,4,5-T] treatment 1 or 4 years previously. ... Overall density and diversity of birds were similar between treated and untreated sites. Several bird species altered patterns of foraging behavior on treated sites. Differences in habitat use were identified for several species; ... The substantial shrub cover on treated sites apparently allowed maintenance of an overall avian density similar to that of untreated sites. Small patches of deciduous trees, scattered about on clearcuts treated with phenoxy herbicides can maintain an avian community that is similar to that on untreated sites. (Author's abstract)

Citation Number 251
Morrison, M. L., and E. C. Meslow. 1983. Impacts of forest herbicides on wildlife; toxicity and habitat alteration. Transactions of the North American Wildlife and Natural Resources Conference 48:175-185.

[This paper reviews both laboratory and field studies on the possible toxic effects of herbicides on birds and mammals. In addition, the indirect effects of herbicides on wildlife habitat and on the palatability of forages are discussed. Data from a study on effects of herbicides on bird and mammal communities in western Oregon are presented and compared with data available from other geographic regions.] (KVM abstract)

Citation Number 252
Morrison, M. L., and E. C. Meslow. 1984. Effects of the herbicide glyphosate on bird community structure, western Oregon. Forest Science 30:95-106.

A study was conducted on vegetative changes induced by the herbicide glyphosate, and the resultant habitat use of birds nesting on two clearcuts in western Oregon. ... No differences in density of the bird community was evident between treated and untreated sites during all years of study although individual species densities were modified. Several bird species decreased their use of shrub cover, and increased their use of deciduous trees 1 year after treatment. By 2 years post-spray, many species had returned to pre-spray use of most measured habitat components. Results indicated that application of glyphosate can modify the density and habitat use of birds. (Author's abstract)

Citation Number 253
Morrison, M. L., and E. C. Meslow. 1984. Response of avian communities to herbicide-induced vegetation changes. Journal of Wildlife Management 48:14-22.

The relationships between avian communities and herbicide modification of vegetation were analyzed on early-growth clear-cuts in western Oregon that had received phenoxy herbicide treatment [2,4-D or 2,4,5-T] 1 or 4 years previously. ... Overall density and diversity of birds were similar between treated and untreated sites. Several bird species altered their foraging behavior on treated sites; i.e., birds using deciduous trees increased use of shrubs on treated sites. The primary effect of herbicide application was a reduction in the complexity of vegetation, a condition due primarily to the removal of deciduous trees. Small patches of deciduous trees scattered in clear-cuts treated with phenoxy herbicides can maintain an avian community similar to that on untreated sites. (Authors' abstract)

Citation Number 254
Mueggler, W. F. 1966. Herbicide treatment of browse on a big-game winter range in northern Idaho. Journal of Wildlife Management 30:141-151.

2,4-D, 2,4,5-T, and a mixture of these two chemicals were tested for effectiveness in lowering the live crown and increasing the basal sprouting of browse grown beyond the reach of elk and deer. ... The mixture of 3 lb/ac was most effective in killing aerial crowns. ... Species differed considerably in reaction to date of spraying. Early summer and late summer spraying were usually more effective than midsummer spraying; however, the study revealed no seasonal pattern that could be used as a general guide for spraying to achieve optimum effectiveness in browse rehabilitation. Limitations governing present use of these herbicides for browse improvement in nothern Idaho should be noted carefully. Only cautious use of spraying is proposed. (Author's abstract)

Citation Number 255

Mullison, W. R. 1972. Ecological effects of herbicides. Down-To-Earth 28:21-24.

[This paper provides some generalizations about the ecological behavior of herbicides including the impact of volatility and drift, actions in the soil, degradation of herbicides, and the effect of herbicides on water, fish, and wildlife. Ecologically, the main effect of herbicides from the wildlife viewpoint is their altering the environment through the control of certain plant species; this brings about changes in the food and habitat for wildife. The longterm effect on wildlife may be beneficial or detrimental, depending on the species involved.] (KVM abstract)

Citation Number 256

Murray, R. B. 1983. Response of antelope bitterbrush to burning and spraying in southeastern Idaho. Pp. 142-152 *in* Proceedings - Research and Management of Bitterbrush and Cliffrose in Western North America. United States Department of Agriculture, Forest Service, General Technical Report INT-152

[Antelope bitterbrush (*Purshia tridentata* Pursh. DC) is a highly preferred species for big game on winter ranges in the Western United States. Long-term response (1936-1979) of bitterbrush is reported for an August 1936 prescribed burn and an accidental 2,4-D spray in 1961. On unburned plots bitterbrush yields in 1966 were more than twice those on burned plots. Spraying with 2,4-D in 1961 resulted in relatively large increases in bitterbrush yields in 1969. ... Big sagebrush studies on spring and late summer burning are included.] (KVM abstract)

Citation Number 257

Neary, D. G., J. E. Smith, B. F. Swindel, and K. V. Miller. 1990. Effects of forestry herbicides on plant species diversity. Proceedings of the Southern Weed Science Society 43:266-269.

Repeated, annual herbicide [sulfometuron methyl, glyphosate, and triclopyr] applications ... strongly reduced plant diversity [on study sites in slash pine flatwoods of North Florida]. Two applications over a year apart produced only a small reduction in diversity. There are insufficient long-term data to adequately analyze the plant diversity impacts of normal operational herbicide use, but the data do suggest minimal long-term impacts. Further research is needed to evaluate individual herbicides, time of application, combinations of herbicides, and effects in different forest ecosystems. Species diversity evaluations will be crucial to analyses of indirect effects of herbicides on wildlife. (Authors' summary)

Citation Number 258

Newton, M. 1975. Constructive use of herbicides in forest resource management. Journal of Forestry 73: 329-336.

Herbicide-based methods have come into use as partial or full substitutes for tools long used in timber stand establishment and management. Some are effective and economical, offering a way to improve resource productivity. Yet their environmental impacts are being questioned in much greater detail than were the practices they replace. This article describes some of the practices and examines some of the questions regarding the relative impacts [on forest systems, including wildlife and wildlife habitat] of some analogous chemical and nonchemical methods. The choice of methods is considered as an active process that takes into account both the advantages and disadvantages of each option in management and social contexts. (Author's abstract)

Citation Number 259
Newton, M., and L. A. Norris. 1976. Evaluating short- and long-term effects of herbicides on nontarget forest and range biota. Down-To-Earth 32:18-26.

[Herbicide effects on nontarget plants and animals are discussed including analysis of short-term chemical effects, effects of herbicides on animals, effects of herbicides on plants, the interaction between plants and animals, and analysis of long-term effects.] (KVM abstract)

Citation Number 260
Newton, M., E. C. Cole, R. A. Lautenschlager, D. E. White, and M. L. McCormack, Jr. 1989. Browse availability after conifer release in Maine's spruce-fir forests. Journal of Wildlife Management 53:643-649.

Even aged management in northern spruce (*Picea* spp.)-fir (*Abies* spp.) forest types may result in significant production of fine woody vegetation <2.5 m tall (i.e., available to browsers) for >10 years after cutting. ... August application of glyphosate or triclopyr and/or phenoxy herbicides 7 years after winter "clearcut" harvest reduced the cover of tall hardwoods and caused a 4- to 8-fold increase in available browse. Nearly all plant species present before herbicide treatment remained >9 years later, but browse available after treatment included a higher proportion of sun-grown foliage and twigs than was found in untreated control plots. Spacing in conifer stands by planting or precommercial thinning should prolong the period of browse availability to >20 years. [Their] data indicate that intensive management designed to increase forest crop production in northeastern spruce-fir ecosystems also dramatically improves conditions for resident browsers. (Authors' abstract)

Citation Number 261
Niering, W. A. 1958. Principles of sound right-of-way vegetation management. Economic Botany 12:140-144.

Right-of-ways occupy a vast acreage of our landscape where vegetation management is necessary. On these areas indiscriminate use of chemical weed killers is widespread even with sound ecological techniques readily available. The application of sound management would not only benefit the utility with reduced costs on a long-range basis but also result in high conservation values to the nation. [Management techniques, including herbicides, are presented that may enhance wildlife habitat on right-of-ways.] (Author's abstract)

Citation Number 262
Niering, W. A., and R. H. Goodwin. 1974. Creation of relatively stable shrublands with herbicides: arresting "succession" on rights-of-way and pastureland. Ecology 55:784-795.

Two decades of selective-herbicide management [2,4,5-T] on a demonstration right-of-way within the Connecticut Arboretum has resulted in a mosaic of relatively stable shrub communities and less stable herblands within the central hardwoods forest region. ... Creating relatively-stable shrub communities by the selective use of herbicides has practical applications in right-of-way and wildlife habitat management, naturalistic landscaping, and the maintenance of habitat diversity. (Authors' abstract)

Citation Number 263
Niering, W. A., and R. H. Goodwin. 1975. Creation of relatively stable shrublands with herbicides: arresting "succession" on rights-of-way and pastureland. Down-To-Earth 31:26-32.

This paper is a condensation of Niering and Goodwin (1974).

Citation Number 264
O'Connell, W. E. 1993. Chemical and mechanical site preparation: effects on plant, small mammal and avian diversity and composition. M.S. Thesis, University of Georgia, Athens. 95pp.

[Pine plantations (in the Sandhills physiographic province of South Carolina) at 2, 3, and 5 years post-treatment that had been site-prepared either by herbicide (hexazinone) or mechanical (root rake/windrow) treatment were investigated. Quail foods (*Colinus virginianus*) were more abundant at 3 years post-treatment on hexazinone-prepared sites. Deer (*Odocoileus virginianus*) vine forage was more abundant on mechanically-prepared sites at 5 years post-treatment, while woody diversity did not differ at any age. Overall, abundance and diversity of small mammals and birds were not different between treatments, although mammals as a group were more abundant in the 2-year-old mechanically prepared sites. Bird diversity was higher on the hexazinone prepared sites at 2 and 3 years post-treatment and was related to the stuctural diversity afforded by remaining snags. Differences in the abundance of individual bird species were related to habitat structure and were no longer evident in the 5 year post-treatment sites.] (DLH abstract)

Citation Number 265
O'Connell, W. E., and K. V. Miller. 1994. Site preparation influences on vegetative composition and avian and small mammal communities in the South Carolina Upper Coastal Plain. Proceedings of the Annual Conference of the Southeastern Association of Fish and Wildlife Agencies 48: (in press).

The composition and diversity of redeveloping plant communities, along with associated small mammal and bird communities, were compared on hexazinone and mechanically-prepared sites at 2, 3, and 5 years post-treatment. Diversity of herbaceous vegetation was higher on the mechanically-prepared sites at 5 years post-treatment, while the diversity of woody vegetation did not differ in any of the age classes. ... On the 2-year post-treatment sites, small mammal capture rates were greater on the mechanically-prepared areas than on the hexazinone sites. Capture rates and species composition did not differ between treatments on the 3- and 5-year post-treatment sites. Bird diversity was higher on the hexazinone-prepared sites at 2 and 3 years post-treatment and apparently was related to greater numbers of residual snags. Differences in the abundance of individual bird species were related to habitat structure and were no longer evident in the 5-year post-treatment sites. (Authors' abstract)

Citaton Number 266
Olawsky, C. D. 1987. Effects of shinnery oak control with tebuthiuron on lesser prairie-chicken populations. M.S. Thesis, Texas Tech University, Lubbock. 83pp.

The herbicide tebuthiuron has been used ... to control sand shinnery oak (*Quercus havardii*) in west Texas and eastern New Mexico. However, the effects of shinnery oak control upon lesser prairie-chicken (*Tympanuchus pallidicinctus*) populations are not known. ... To determine the effects of shinnery oak control on lesser prairie-chickens, [the author] made several comparisons between tebuthiuron-treated and untreated shinnery rangelands including: (1) vegetation composition, (2) densities of lesser prairie-chickens, (3) early summer diets and gut morphology, and (4) body condition of lesser prairie chickens. Forb and grass composition was higher in treated plots than in untreated plots. Densities of lesser prairie-chickens were slightly higher in tebuthiuron-treated sites than in untreated plots ... [in both summer and winter]. ... Foods eaten ... in treated pastures were different than foods eaten ... in untreated pastures. ... Differences in the sizes of digestive organs corresponded to differences in diet. ... Lesser prairie-chickens collected from untreated shinnery ... were in better overall condition. ... Lesser prairie-chickens could most likely benefit from an interspersion of both tebuthiuron-treated and untreated sand shinnery oak rangeland. (Author's abstract)

Citation Number 267
Oliveri, S. F. 1986. The implications of intensive forest management practices for wildlife in Maine. Pp. 259-267 *in* J. A. Bissonette, ed. Is good forestry good wildlife management? Maine Agricultural Experiment Station, Miscellaneous Publication 689.

The effects of 10 intensive forest management practices upon wildlife are reviewed. Herbicides, shorter rotations, road development, clearcutting, whole-tree and biomass harvesting, hardwood utilization and stand conversion, thinning, planting, fire control, and insecticides are prominent practices that have both positive and negative effects upon different wildlife species. (Author's abstract)

Citation Number 268
Osaki, S. K. 1979. An assessment of wildlife populations and habitat in herbicide-treated Jeffrey pine plantations. M.S. Thesis, University of California, Berkeley. 83pp.

In the summers of 1977 and 1978 wildlife populations and habitat variables were sampled within young Jeffrey pine plantations in the 1960 Donner burn. Sites treated with 2,4,5-T 6 to 7 years prior to sampling were compared with similar untreated sites. ... No significant differences in small mammal abundance were detected although 7 of 9 species seemed to be favored by untreated habitat. Deer (*Odocoileus hemionus*) use appeared to be slightly greater on treated sites while snowshoe hare (*Lepus americanus*) use was lower on treated sites. Avian populations appeared to be more sensitive to the measured differences in habitat variables. ... The habitat variables and animal populations were consequently more variable on treated than untreated sites. In contrast to a previous study of the area which sampled only one heavily treated site, this study found no severe impacts to wildlife ... 6 to 7 years post-treatment. ... (Author's abstract)

Citation Number 269
Parker, J. R., J. J. Brooks, W. E. O'Connell, K. V. Miller, and A. S. Johnson. 1993. Response of deer forage to various site preparation treatments in the Coastal Plain. Annual Meeting of the Southeat Deer Study Group Meeting, Jackson, Mississippi 16:36.

[The authors] evaluated the effects of various chemical and mechanical site preparation treatments on deer forages on sandy uplands at two locations in the Upper Coastal Plain. In South Carolina, ... the effects of hexazinone and a sheer, rootrake, and windrow treatment on deer forages at 1, 2, and 4 years post-treatment [were evaluated]. In Georgia, ... [the effects of] hexazinone, imazapyr, picloram + triclopyr, and imazapyr [were compared] at 1 and 2 years post treatment. ... On the South Carolina area, no significant differences were found among vines, desirable woody browse, grasses, or forbs at 1 and 2 years post treatment; however, in 4-year-old stands, vines were significantly higher in abundance on mechanical treatments. On the Georgia area, hexazinone treatments supported significantly more desirable woody browse than imazapyr treatments at year 1 and more than either of the other treatments at year 2. The abundance of vines was similar among treatments. Although grasses were higher in abundance on picloram + triclopyr treatments at year 1, there were no treatment differences by year 2. Differences in forbs were less apparent, though legumes were more abundant on imazapyr treatments. Overall, deer forage was similar between hexazinone and a mechanical treatment, but hexazinone provided a greater abundance of deer forage than other herbicide treatments. (Authors' summary)

Citation Number 270
Pase, C. P., P. A. Ingebo, E. A. Davis, and C. Y. McCullough. 1967. Improving water yield and game habitat by chemical control of chaparral. Proceedings of the IUFRO World Congress14:463-486.

Citation Number 271
Perkins, C. J. 1973. Effects of clearcutting and site preparation on the vegetation and wildlife in the flatwoods of Kemper County, Mississippi. Ph. D. Dissertation, Mississippi State University, Mississippi State. 326pp.

[The objective of this study was to compare the floristic composition in an uncut forest, and in clearcuts that were site prepared either by shearing, windrowing, burning, and bedding or by mistblowing herbicides. Avifauna and small mammal populations are described for each treatment. Site preparation vastly improved the environment for most species.] (KVM abstract)

Citation Number 272
Perkins, C. J., G. A. Hurst, and E. R. Roach. 1988. Relative abundance of small mammals in young loblolly pine plantations. Pp. 589-591 *in* Proceedings of the Fifth Biennial Southern Silvicultural Research Conference, United States Department of Agriculture, Forest Service, General Technical Report SO-74

Trapping indices for small mammals on bedded loblolly pine (*Pinus taeda*) plantations, age 1-3 years, were 20.6, 18.7, and 14.0; and on herbicide site prepared plantations, age 1-4 years, were 29.9, 16.6, 14.1, and 11.3. The index was 0.22 for mature pine-hardwood forests, Kemper County, Mississippi. [Herbicides used were 2,4-D and 2,4,5-T. Small mammals listed include cotton rat, rice rat, house mouse, white-footed mouse, and short-tailed shrew.] (Authors' abstract)

Citation Number 273
Player, R. L., and P. J. Urness. 1982. Habitat manipulation for reestablishment of Utah prairie dogs in Capitol Reef National Park. Great Basin Naturalist 42:517-523.

Utah prairie dogs were transplanted onto the site of a former colony, located in Capitol Reef National Park, Utah. Shrubs on the site were significantly taller than those found on active colonies in similar habitat located on the Awapa Plateau. Therefore, the transplant site afforded a test of the hypothesis that shrub height is a major inhibitory factor affecting occupation of sites by prairie dogs. ... Vegetation treatments - rotobeating, railing, and 2,4-D herbicide - were carried out on three ... sites [and a control]. ... Results indicated that, when transplanting animals onto sites of former colonies presently overgrown with shrubs, the chances of a successful transplant could be increased by first reducing shrub height and density [including the use of herbicides]. (Authors' abstract)

Citation Number 274
Pletscher, D. H., and R. J. Robel. 1979. Possible use of 2,4-D in management of sunflower and ragweed. Wildlife Society Bulletin 7:48-53.

[The effects of low levels of 2,4-D on subsequent seed composition and production of sunflower (*Helianthus annuus*) and ragweed (*Ambrosia artemisiifolia*) plants was studied on Fort Riley Military Reservation, Kansas. Results indicate that low dosages of 2,4-D may increase sunflower seed production. These preliminary results suggest that low-level applications of synthetic auxins could be a beneficial tool in bobwhite quail management.] (KVM abstract)

Citation Number 275
Quimby, D. C. 1966. A review of literature relating to the effects and possible effects of sagebrush control on certain game species in Montana. Proceedings of the Annual Conference of the Western Association of State Game and Fish Commissioners 46:142-149.

[The author suggests that relationships between certain wildlife species and the occurrence of sagebrush and related plants are so intricate that any program that removes sagebrush and related forbs can be viewed potentially damaging to the welfare of these wildlife species until proven otherwise. The author

presents some specific information concerning the food habits of certain wildlife species to justify this conclusion. The species include pronghorn antelope, sage grouse, mule deer, elk, white-tailed deer, moose, and bighorn sheep. Herbicide discussed is 2,4-D.] (KVM abstract)

Citation Number 276
Reitzel, J. A. 1982. The effects of brush control on bird populations in mesquite community. M.S. Thesis, New Mexico State University, Las Cruces. 55pp.

This study dealt with the effects that brush control, by aerial application of 2,4,5-T had on indigenous bird populations in a mesquite community in southern New Mexico. ... Species richness was greater in the unsprayed area in the duny subtype, but was approximately equal in sprayed and unsprayed areas in the flats. Dominance composition differed little between treatment areas. ... The evidence for an effect on bird diversity was weak, but may indicate a lower diversity in the sprayed duny mesquite. ... In conclusion, it appears that mesquite control has a detrimental effect on populations of some bird species. These differences are more pronounced in the first year of study, possibly because of the mesquite regrowth which occurred the following year. (Author's abstract)

Citation Number 277
Ritchie, D. C., A. S. Harestad, and R. Archibald. 1987. Glyphosate treatment and deer mice in clearcut and forest. Northwest Science 61:199-202.

Prior to planting conifers, herbicides are commonly used to reduce competition from deciduous trees and shrubs. Herbicides are usually not toxic to wildlife but do affect their habitats. [The authors] examined deer mice (*Peromyscus maniculatus*) to assess the impact of herbicides on small mammals. Deer mice from adjacent untreated and glyphosate-treated clearcuts had similar body sizes and numbers of placental scars and foeti. In untreated clearcut, deer mice were more abundant than in treated clearcut, but were less abundant than in surrounding old growth forest. Glyphosate altered vegetation and reduced density of deer mice in young seral stages. Habitat changes induced by glyphosate likely modified abundance and quality of food and cover for small mammals. (Authors' abstract)

Citation Number 278
Rodgers, R. D. 1983. Reducing wildlife losses to tillage in fallow wheat fields. Wildlife Society Bulletin 11:31-38.

In the wheat-fallow system [used on about 33 million ha in 17 states and 3 Canadian Provinces], surface tillage for spring weed control destroys ... nests and flightless young in stubble [including those of ring-necked pheasants (*Phasianus colchicus*), sharp-tailed grouse (*Pediocetes phasianellus*), shorebirds (Scolopacidae, Charadriidae), and ducks (*Anas* spp.)], and kills or injures many incubating adults. Undercutters without mulch treaders saved ... nests, permitted survival of many flightless young, and caused no known injury to incubating adults during the spring weed control operation. Subsequent nest success was high. ... Fallow weed control with safe herbicides holds potential for providing undisturbed stubble for nesting. (Author's summary)

Citation Number 279
Rodrigue, J. L. 1994. The effects of chemical site preparation on the diversity and composition of forest vegetation and small mammal communities. M.S. Thesis, University of Georgia, Athens. 78pp.

[Three herbicide site preparation treatments (hexazinone, picloram + triclopyr, and imazapyr) were evaluated 2 and 3 years post-treatment for effects on white-tailed deer (*Odocoileus virginianus*) and bobwhite quail (*Colinus virginianus*) foods, and small mammal abundances and diversity in the Sandhills Region of Georgia. During both years, woody species diversity was highest on picloram + triclopyr

treatments. Picloram + triclopyr treatments also had a slightly higher herbaceous species diversity at 2 years post-treatment, while imazapyr treatments had the highest diversity at 3 years post-treatment. During years 2 and 3, hexazinone and picloram + triclopyr produced more woody browse than imazapyr treatments, while more herbaceous forage was found on the imazapyr sites. During both years post-treatment, hexazinone and picloram + triclopyr sites contained the greatest amount of woody plant foods for quail, and herbaceous quail food was more abundant on the imazapyr treatments. *Peromyscus* spp. accounted for 81% of all small mammal captures. No differences were found in capture rates among treatments during both years post-treatment. There were several correlations between small mammal capture rates and vegetative characteristics.] (DLH abstract)

Citation Number 280
Roe, E. T. 1955. Possibilities of aerial spraying in forest management in the Lake States. Proceedings of the North Central Weed Control Conference 12:109-112.

[The use of aerial applications of 2,4,5-T in the Lake States for forest management is discussed. Plantation release, preparation of brushy sites for planting, conversion of low-grade aspen to conifers, encouraging conifer reproduction on brushy land and creating conditions favorable for wildlife through the use of herbicides are reviewed.] (KVM abstract)

Citation Number 281
Rollings, C. T. 1959. Use of herbicides in the improvement of marsh habitat for waterfowl on national wildlife refuges in the Upper Midwest States. Proceedings of the North Central Weed Control Conference 16:41.

[Numerous herbicides were evaluated on national wildlife refuges in the north central United States to create openings in solid stands of vegetation for waterfowl. Herbicides tested included ureabor, erbon, amitrol, and dalapon. The author concludes that herbicides will serve as a valuable supplement to more conventional techniques for controlling marsh vegetation on national wildlife refuges in the north central states.] (KVM abstract)

Citation Number 282
Ruch, L. C. 1956. Creating and maintaining openings in wood areas by the use of herbicides. Proceedings of the North Central Weed Control Conference 13:28-29.

[Maintenance of favorable wildlife on game lands was attempted using 2,4-D and/or 2,4,5-T. Herbicides were found to be valuable in treating open fields, woodland edge, trails, and solid stands of low-growing vegetation to improve habitat for rabbits, ruffed grouse, sharp-tailed grouse and deer.] (KVM abstract)

Citation Number 283
Ruch, L. C. 1957. Creating and maintaining wildlife openings in wooded areas by use of herbicides. Down-To-Earth 12:2-3, 16.

See Ruch (1956)

Citation Number 284
Santillo, D. J. 1986. Glyphosate and wildlife habitat in Maine. Proceedings of the Northeastern Weed Science Society 40:25.

... Effects of glyphosate induced habitat changes on songbirds and small mammals are being examined on 1-, 2-, and 3-year post-treatment clearcuts. ... Both songbirds and small mammals were less abundant on 2-year post-treatment sites than on untreated control sites. "Skip" areas, or areas missed during

treatment, appear to be important in maintaining the diversity of the bird community on treated clearcuts. The difference in total captures of small mammals on untreated and 2-year post-treatment sites was primarily due to disparity in captures of masked shrews (*Sorex cinereus*). ...
(Author's abstract)

Citation Number 285
Santillo, D. J. 1987. Response of small mammals and breeding birds to herbicide-induced habitat changes on clearcuts in Maine. M. S. Thesis, University of Maine. 74pp.

The effects of herbicide-induced habitat changes on small mammals and songbirds were investigated in north-central Maine during 1985-86. Changes in small mammal and songbird populations were compared to differences in vegetation on untreated and herbicide-treated clearcuts, 1 to 3 yrs after application of herbicides [glyphosate] for conifer release. ... Fewer small mammals were captured on herbicide-treated clearcuts than on untreated clearcuts for all 3 yrs post-treatment. ... Differences in small mammal populations were explained by a reduction of invertebrate and plant food on herbicide-treated sites, and the herbicide-induced reduction in cover. ... Total bird densities were lower on herbicide-treated clearcuts ($P<0.05$). ... The influence of site tenacity and time lag in response of birds to the habitat alteration were discussed. Pockets of vegetation missed during application of herbicides (skips) were found to be important as a source of cover and food. ... (Author's abstract)

Citation Number 286
Santillo, D. J., D. M. Leslie, Jr., and P. W. Brown. 1989. Response of small mammals and habitat to glyphosate application on clearcuts. Journal of Wildlife Management 53:164-172.

[The authors] investigated effects of herbicide-induced habitat changes on small mammals in clearcuts in northcentral Maine. Fewer small mammals were captured on glyphosate ... treated clearcuts 1-3 years post-treatment compared to untreated clearcuts. Insectivores (Soricidae) comprised 72% of small mammal captures and were less abundant ($P<0.001$) for all three years post-treatment. Herbivores (Microtinae) were less abundant 1 ($P<0.01$) and 2 years ($P<0.001$) post-treatment. Omnivores (Cricetinae and Zapodidae) were equally abundant on treated and untreated clearcuts. Differences in small mammal abundance paralleled herbicide-induced reductions in invertebrates and plant food and cover. Patches of untreated vegetation within herbicide-treated clearcuts provided a source of invertebrates and plant food and cover. (Authors' abstract)

Citation Number 287
Santillo, D. J., P. W. Brown, and D. M. Leslie, Jr. 1989. Response of songbirds to glyphosate-induced habitat changes in clearcuts. Journal of Wildlife Management 53:64-71.

[The authors] examined breeding bird populations and habitats on glyphosate ... treated and untreated clearcuts in north-central Maine. Treatment of clearcuts with glyphosate herbicide reduced the complexity of vegetation through 3 years post-treatment compared to untreated clearcuts. Total numbers of birds, common yellowthroats (*Geothlypis trichas*), Lincoln's sparrows (*Melospiza lincolnii*), and alder flycatchers (*Empidonax alnorum*) were less abundant ($P<0.05$) on treated clearcuts than on untreated clearcuts. Songbird densities were correlated with habitat complexity, especially hardwood regeneration, foliage height diversity, and vegetation height. Leaving untreated patches of vegetation and staggering herbicide treatments on large clearcuts will maintain bird populations similar to those on untreated clearcuts. (Authors' abstract)

Citation Number 288
Santillo, D. J. 1994. Observations on moose, *Alces alces*, habitat and use on herbicide-treated clearcuts in Maine. Canadian Field-Naturalist 108:22-25.

[The author] studied habitat and use on glyphosate (nitrogen-phosphonomethyl glycine) (Roundup, Monsanto, St. Louis, Missouri)-treated and untreated clearcuts in north-central Maine. Available browse plants were less abundant on 2-year post-treatment clearcuts compared with untreated clearcuts, except within areas missed during herbicide treatment. Available browse within these skipped areas was similar to that of untreated clearcuts but use was 3.8 times greater in skipped areas. Based on browse use and pellet group distribution, areas of clearcuts missed during treatment were used extensively by moose. Leaving untreated patches of vegetation in large treated clearcuts is recommended. (Author's abstract)

Citation Number 289
Savidge, J. A. 1977. Effects on wildlife of herbicide induced habitat change, Tahoe National Forest. M.S. Thesis, University of California, Berkeley. 16pp.

[This] study was designed to compare vegetation and animal populations on a plot sprayed with [2,4,5-T] six years previously with a similar unsprayed plot. Herbicide spraying ... induced changes in shrubby vegetation which depressed nesting bird populations and summering mule deer populations but stimulated an increase in some rodents. Although this was only a pilot study, the results raise some serious questions concerning environmental effects of herbicides, suggesting the need for further investigation. (Author's summary)

Citation Number 290
Savidge, J. A. 1978. Wildlife in a herbicide-treated Jeffrey pine plantation in eastern California. Journal of Forestry 76:476-478.

In a plantation of Jeffrey pine (*Pinus jeffreyi*) Grev. and Balf.), spraying with 2,4,5-T thinned some brush species (*Ceanothus velutinus* Dougl. in particular) while encouraging others. The change in vegetation substantially reduced populations of resident birds, both in numbers of individuals and species. Mule deer likewise were reduced in number on the sprayed area. Conversely, some small mammals, particularly chipmunks, increased. (Author's abstract)

Citation Number 291
Schemnitz, S. D., and W. R. Byrnes. 1963. Wildlife utilize power line rights-of-way. Science for the Farmer 10:3.

[A right-of-way in Center Co., Pennsylvania was treated in 1953 with basal or broadcast sprays of either 2,4-D, 2,4,5-T, or Ammate to determine the effects of herbicide application on wildlife habitat. After 9 years of regrowth, power line rights-of-way treated with herbicides remained atractive to deer, rabbits, wild turkey, and ruffed grouse. Wildlife usage of study plots in 1962 equalled or exceeded the rate of usage found on these same areas in 1954, one year after chemical treatment.] (KVM abstract)

Citation Number 292
Schemnitz, S. D. 1976. The effects of forest management practices on wildlife in eastern United States. Proceedings of the IUFRO World Congress 16:700-730

A review was made of current forest management practicesin the eastern United States as they influence wildlife populations. Emphasis was placed on the role of timber harvest and intermediate silvicultural treatments (timber stand improvement). Other forest practices that were evaluated included stand conversion and type rehabilitation, artificial reforestation, forest openings, controlled burning, forest fertilization, forest range management, green tree reservoirs, and chemical applications (herbicides,

pesticides, and chemical debarking). Response of non-game birds, raptors, forest grouse, and wild turkey and endangered woodpeckers to particular forest management practices were discussed. Mammalian species groups receiving detailed consideration were large herbivores and bear, furbearers, and forest rodents. (Author's summary)

Citation Number 293
Schroeder, M. H. 1972. Relationships of range and forest management with herbicides on wildlife. Proceedings of the Western Weed Science Society 25:11-15.

[A review of the literature on the direct and indirect effects of herbicide vegetation management on ranges and forests on wildlife is presented. The author concludes that] herbicides have many uses that benefit wildlife, but it will be remembered that as with any pesticide tool, the herbicidal swords have two edges; one to benefit, the other can harm. To derive the benefit from herbicide use, land managers must work within the multiple use concept and consider wildlife, both game and nongame, when planning vegetal control programs. (KVM abstract)

Citation Number 294
Schroeder, M. H., and D. L. Sturges. 1975. The effect on the Brewer's sparrow of spraying big sagebrush. Journal of Range Management 28:294-297.

Three sagebrush plants containing Brewer's sparrow nests with eggs were sprayed with 2,4-D. Comparison of these to three nests in unsprayed brush showed no evidence that the herbicide spray reduced nest successduring the year of application. Brewer's sparrow use of a sprayed sagebrush stand 1 and 2 years after spraying was 67% and 99% lower, respectively, than use on an unsprayed stand, and no evidence of nesting was found on the sprayed stand. (Authors' abstract)

Citation Number 295
von Schuckmann, S. 1986. The implications of brush control to wildlife and fish. Pp. 63-76 *in* Proceedings of the Vegetation Management Symposium, Association of British Columbia Professional Foresters.

Citation Number 296
Schulz, C. A., D. M. Leslie, Jr., R. L. Lochmiller, and D. M. Engle. 1992. Autumn and winter bird populations in herbicide-treated Cross Timbers in Oklahoma. American Midland Naturalist 127:215-223.

Birds were counted during autumn and winter from October 1987 through February 1989 on sites in Cross Timbers in central Oklahoma 5 and 6 years after herbicide treatments [with tebuthiuron and triclopyr]. ... During autumn and winter, more birds and more species were found on sites treated with herbicidies than on reference sites. Tebuthiuron- and triclopyr-treated sites supported similar numbers of species during both seasons. Herbicide treated sites had the highest species richness, but untreated areas were needed to maintain interior woodland species. (Authors' abstract)

Citation Number 297
Schulz, C. A., D. M. Leslie, Jr., R. L. Lochmiller, and D. M. Engle. 1992. Herbicide effects on Cross Timbers breeding birds. Journal of Range Management 45:407-411.

[The authors] censused breeding nongame birds on replicated 5- and 6-year post herbicide-treated (tebuthiuron and triclopyr) and untreated cross timbers rangeland in central Oklahoma. ... No treatment effects were detected for total bird density, species diversity, or richness; however, species composition varied considerably among treatments. Control sites supported species associated with closed canopy woodlands, and treated sites supported species associated with brushy and prairie habitat. Generally, control sites had

greater foliar cover, fewer snags, and less slash and herbaceous cover than treated sites. ... [The authors] concluded that changes in habitat structure resulted in differences in bird species composition among treatments. (Authors' abstract)

Citation Number 298
Scifres, C. J., and J. L. Mutz. 1978. Herbaceous vegetation changes following applications of tebuthiuron for brush control. Journal of Range Management 31:375-378.

Aerial application of 2.24 kg/ha (a.i.) of tebuthiuron pellets to mixed brush and whitebrush-dominated stands in South Texas significantly increased grass standing crops at 1, 2, and 3 years after treatment. ... Forb production and diversity were decreased where 1 kg/ha or more of the herbicide was applied, and the detrimental effect on forbs increased with increasing application rate. Forb production was nearly eliminated for 2 years following application of 4.48 kg/ha of tebuthiuron but recovery of the population was evident after 3 years regardless of rate of application. [To assure an adequate forb population for white-tailed deer, a patterned application would be advisable.] (Authors' abstract)

Citation Number 299
Scifres, C. J. 1978. Range vegetation management with herbicides and alternative methods: an overview and perspective. Pp. 151-165 *in* D.E. Ketcham , ed. The Use of Herbicides in Forestry. United States Department of Agriculture, Washington, D.C.

Undesirable vegetation and its management on rangeland is an ecological problem that must be considered within a rather narrow economic framework. ... Herbicides can be used to promote range livestock production without being detrimental and, in some cases, may be beneficial to quality wildlife habitat. Recognition of potential hazards to wildlife habitat allows planning applications to eliminate detriment to most game species. ... (Author's summary)

Citation Number 300
Scifres, C. J., and B. H. Koerth. 1986. Habitat alterations in mixed brush from variable rate herbicide patterns. Wildlife Society Bulletin 14:345-356.

Structural and botanical features of mixed-brush landscapes in south Texas were evaluated after aerial application of tebuthiuron in variable rate patterns (VPRs) [0, 1.1, 2.2, 3.3, and 4.4 kg/ha]. ... Forb cover and diversity were a function of the interaction of herbicide dosage with range site and rainfall. ... VPRs are proposed as viable alternatives to strip patterning of herbicide applications because the patch effect offers a highly diverse vegetation mosaic over the landscape and an asymmetry which amplifies edge effect. ... The versatility of pattern design allows development of carefully planned VRPs to optimize livestock and wildlife management goals. (Authors' abstract)

Citation Number 301
Segelquist, C. A., M. J. Rogers, and F. D. Ward. 1976. Response of Japanese honeysuckle to management in the Arkansas Ozarks. Proceedings of the Annual Conference of the Southeastern Game and Fish Commissioners 29:370-373.

Honeysuckle planted in 1968 [for wildlife habitat improvement] consistently yielded more than 2,000 kg of leaves and twigs per ha after 1972. Fertilization with N subsequently increased total vegetative yields and crude protein content of leaves. ... Despite high yields, there was evidence that an effective means of weed control would be necessary to prevent woody species from eventually suppressing the honeysuckle. Mowing was not sufficient control, and spraying with 2,4,5-T killed honeysuckle as well as native woody species. (Authors' abstract)

Citation Number 302
Shipman, R. D., and J. B. Schmitt. 1971. Timber, wildlife improved with fenuron herbicide. Science in Agriculture 19:2-5.

[Experiments indicated that undesirable vegetation can be successfully controlled with fenuron herbicide. Defoliation and killing of 'weed' trees improved survival and growth rate of underplanted Japanese Larch seedlings, and increased production of ground vegetation well-suited for wildlife food and cover.] (KVM abstract)

Citation Number 303
Short, H. L., and C. Y. McCulloch. 1977. Managing pinyon-juniper ranges for wildlife. United States Department of Agriculture, Forest Service, General Technical Report RM-47. 10pp.

[Effects of various pinyon-juniper range management practices, including use of herbicides, on wildlife species is discussed. The authors caution that the possibility of destroying midstory shrubs important as food sources, and the esthetically distasteful appearance of dead snags are major disadvantages to herbicide use. Perhaps the greatest disadvantage, however, is the danger that the gross misuse of chemicals might destroy rather than manage a forest type that is important to wildlife in the United States.] (KVM abstract)

Citation Number 304
Slagsvold, T. 1977. Bird population changes after clearance of deciduous scrub. Biological Conservation 12:229-244.

Clearance of deciduous scrub by cutting in Valdres, South Norway, or by spraying with 2,4,5-T, was followed by a 30% reduction in the number of bird territories in the following spring. The recorded changes were related to differing preferences of the bird species for successional stages of vegetation, i.e. the pioneer species increased while those which prefer old forest were heavily reduced. Four years later the bird population as a whole had increased in the cut area, but not in the sprayed area. The results are discussed in relation to changes in the invertebrate fauna and the vegetation of the habitat. ... (Author's abstract)

Citation Number 305
Smith, K. G., and D. R. Petit. 1988. Breeding birds and forestry practices in the Ozarks: past, present, and future relationships. Bird Conservation 3:23-46.

[The authors document changes in the avifauna of the Ozarks that have occurred over the last 150 years due to human activities (including the use of herbicides) and characterize avian communities present in the Ozarks today. The authors speculate on the impacts that increased demand for forests and urban development will have on bird populations in the Ozarks in the future.] (DLH abstract)

Citation Number 306
Smith, M. W. 1981. Comments on herbicide injection for habitat maintenance of red-cockaded woodpecker colonies. Mississippi Kite 11:52-53.

[The author discusses the loss of cavity trees by allowing population increases of southern pine beetles within the colony as understory pines are injected with herbicides to acheive a more open environment (basal areas of 50 or 60 square feet per acre)] (DLH abstract)

Citation Number 307

Snyder, W. D. 1992. Upland bird research: sandsage-bluestem prairie renovation. Colorado Division of Wildlife, Final Report., Project No. CO W-152-R. 203pp.

Prescribed burns, tillage-herbicide and herbicide renovation, and revegetation treatments were applied to sites within the Tamarack Prairie during 1984-86 to increase the proportion of tall, warm season grasses and height-density of standing residual, and reduce the composition of sand sagebrush (*Artemisia filifolia*). ... Aerial application of 2,4-D herbicide to thin stands of sand sagebrush resulted in near total kill of sage and severe repression of forbs. [Effects on prairie grouse are discussed]. ... (Author's abstract)

Citation Number 308

Solberg, K. L., and K. F. Higgins. 1993. Effects of glyphosate herbicide on cattails, invertebrates, and waterfowl in South Dakota wetlands. Wildlife Society Bulletin 21:299-307.

The feasibility and effectiveness of using glyphosate herbicide to create openings in dense cattail stands in semipermanent wetlands and its possible effects on ducks and aquatic invertebrates in northeastern South Dakota [was studied]. ... [The herbicide] effectively controlled cattails, but treatment duration was related to water regime. Breeding ducks and over-water duck nest densities were greater on wetlands with chemically-created openings. [The authors' findings and a review of the literature] suggest that ... (glyphosate) herbicide is an acceptable management tool to create wetland openings that enhance waterfowl use and production. [The authors] were unable to determine if ... differences in invertebrate abundance were caused by direct mortality from the glyphosate treatment or to movements of some invertebrates from treated to untreated areas within wetlands. (Authors' summary)

Citation Number 309

Soper, R. B., R. L. Lochmiller, D. M. Leslie, Jr., and D. M. Engle. 1989. White-tailed deer movements and browse quality as influenced by brush management. Annual Meeting of the Southeast Deer Study Group, Oklahoma City 12:19.

... [The] objective was to monitor deer movement patterns, habitat selection, and browse quality on the Cross Timbers Experimental Range (CTER) near Stillwater, Oklahoma. The CTER is a 650-ha research area divided up into 20 32.5-ha herbicide treated (tebuthiuron and triclopyr herbicides with or without prescribed burning and untreated control) pastures with 4 replications of each treatment. Eleven [deer] were captured, fitted with transmitters, and monitored throughout 1988 to determine home range size and daily movement patterns and responses to experimental treatments. Seven common browse species were collected throughout 1988 from 2 replications and analyzed for crude protein. Deer movement data indicated home range sizes were relatively small. Brush control treatments also influenced quality of key browse plants of white-tailed deer. (Authors' abstract)

Citation Number 310

Soper, R. B., R. L. Lochmiller, D. M. Leslie, Jr., and D. M. Engle. 1993. Nutritional quality of browse after brush management on cross timbers rangeland. Journal of Range Management 46:399-410.

[The authors] evaluated changes in browse quality 5-6 years after experimental manipulation to control unwanted woody vegetation using combinations of herbicide and fire on cross timbers rangeland in central Oklahoma. ... Nutritional quality of blackberry (*Rubus* spp.), coralberry (*Symphoricarpos orbiculatus* Moench), rough-leaf dogwood (*Cornus drummondii* Meyer), elm (*Ulmus* spp.), greenbrier (*Smilax* spp.), hackberry (*Celtis* spp.), and smooth sumac (*Rhus glabra* L.) were assessed ... Crude protein concentrations of browse were 14% higher on herbicide-treated areas compared to untreated controls and 11% higher on triclopyr treatments compared to tebuthiuron treatments. In vitro dry matter digestibility was 9% higher on herbicide-treated areas compared to untreated controls. Fiber constituents and moisture content

were not influenced by brush treatments. Prescribed burning combined with herbicide applications did not improve the quality of browse. ... results indicate that browse quality can be improved for white-tailed deer by applications of tebuthiuron or triclopyr and improvements persist for up to 6 years post treatment. (Authors' abstract)

Citation Number 311
Sosebee, R. E., and B. E. Dahl. 1980. Effects of mesquite spraying on other rangeland resources. United States Department of the Interior, Bureau of Land Management, Technical Note 341. 387pp.

[The authors provide a comprehensive review of the literature pertaining to the pertinent scientific research on the effect of all herbicides used in spraying mesquite (*Prosopis* spp). Effects on other resources such as watershed values, associated vegetative composition, wildlife habitat, livestock forage production,and aesthetic values of spraying are reported. Wildlife habitat is subdivided into antelope and other big game, upland game birds, birds of prey, other birds, predators, rodents, reptiles, fish, and amphibians.] (KVM abstract)

Citation Number 312
Soutiere, E. C., and E. G. Bolen. 1976. Mourning dove nesting on tobosa grass-mesquite rangeland sprayed with herbicides and burned. Journal of Range Management 29:226-231.

A 2-year study of the effects herbicide spraying, and particularly prescribed burning might have on mourning dove (*Zenaida macroura*) nesting ecology in rangelands infested with mesquite revealed that the loss of trees as nesting sites was compensated by the occurrence of ground nesting. Newly burned areas fostered better utilization (i.e., higher nesting densities) than did older burns except under drought conditions. Ground nests did not suffer from excessive predation, and differences in the productivity of ground nests probably were related to nesting density rather than to the apparent suitability of the site. Ground nests were more successful than tree nests. (Authors' abstract)

Citation Number 313
Spencer, S. R., and G. W. Barrett. 1980. Meadow vole population response to vegetational changes resulting from 2,4-D application. American Midland Naturalist 103:32-46.

The effects of a herbicide (2,4-D) on the small mammal component of an old-field community were investigated. The study area consisted of two 0.4-ha plots surrounded by ... walls, into which 7 pairs of meadow voles (*Microtus pennsylvanicus*) were introduced. An amount equal to 567.5 g/ha of ... 2,4-D, mixed in 151.4 liters of water, was applied to 1 of the experimental plots ... Meadow vole population dynamics were monitored by trapping twice weekly ... The control plot reached a peak density of 116 animals/0.4 ha ... the treated plot reached a peak density of 68 voles/0.4 ha ... Male:female sex ratios were skewed in favor of males in the treated grid, mainly because of reduced female survival rates. ... It appears that voles in the treated grid, which became essentially a 'monoculture type' giant foxtail (*Setaria faberii*) habitat, were subjected to food quality differences (e.g., protein deficiencies) as compared to voles in the more diverse untreated habitat. (Authors' abstract)

Citation Number 314
Stamm, K. 1964. Use of herbicides in forestry and game management. University of Wisconsin Agriculture Extension Service. 126pp.

[Recommendations on herbicide types, rates, and timing of application for game wildlife habitat improvement (food patch establishment, removal of undesirable vegetation, etc.) are provided. Chemical discussed include simazine, dalapon, 2,4-D, and 2,4,5-T.] (KVM abstract)

Citation Number 315
Standley, W. G., and N. S. Smith. 1988. Effects of treating creosotebush with tebuthiuron on rodents. Pp. 422-431 *in* R. C. Szaro, K. E. Severson, and D. R. Patton, tech. coords. Proceedings of the Symposium, Management of Amphibians, Reptiles, and Small Mammals in North America. United States Department of Agriculture, Forest Service, General Technical Report RM-166.

Three years after creosotebush (*Larrea tridentata*) was treated with tebuthiuron, rodent abundance was 71% higher on treated plots than on control plots in southeastern Arizona. Arizona cotton rats (*Sigmodon arizonae*) and western harvest mice (*Reithrodontomys megalotis*) were more abundant while the abundance of Merriam's kangaroo rats (*Dipodomys merriami*) was similar. [The authors] concluded that tebuthiuron may be safely used to control creosotbush in semidesert grasslands unless the presence of rare and endangered species precludes any alterations to the community. (Authors' abstract)

Citation Number 316
Steenis, J. H. 1950. Studies on the use of herbicides for improving waterfowl habitat in western Kentucky and Tennessee. Journal of Wildlife Management 14:162-168.

During four years of investigation on the use of herbicides to control pest plants in waterfowl habitat in western Kentucky and Tennessee, it was found that: 1) Ammate at 0.75 lb/gal and 2,4-D at 0.6% strength [are] effective on many plants, including important pest species such as lotus, giant cutgrass, and several woody species. ... 2) For non-hormone types of chemicals, such as Ammate, best results are [obtained] when treatment causes maximum shock to the plant. 3) Best results with the hormone-type herbicide, such as 2,4-D, were obtained during active vegetation growth ... 4) Successive treatments of 2,4-D and Ammate ... were used on hard-to-kill woody sucker growth. 5) Effective application of herbicides in waterfowl areas requires procedures that will result in economical replacement of objectionable vegetation by more desirable plants. (Author's summary)

Citation Number 317
Steenis, J. H. 1950. Waterfowl habitat improvement on Reelfoot Lake. Journal of the Tennessee Academy of Science 15:56-64.

[Techniques used to improve waterfowl habitat on Reelfoot Lake in Tennessee are discussed. Herbicides (2,4-D, ammate, Altacide, and sodium chlorate) are used for vegetation improvement to control numerous woody and herbaceous undesirable weeds.] (KVM abstract)

Citation Number 318
Steenis, J. H. 1960. Aquatic weed control. Pp. 33-39 *in* R.E. McDermott and W.R. Byrnes, eds. Herbicides and Their Use in Forestry. School of Forestry, Pennsylvania State University.

Control of problem plants is becoming one of the major means of improving marshes for waterfowl and other wildlife. Since many of the problem plants of wet areas are perennials that show varied reactions to herbicides, it often is necessary to develop specific control procedures for each species. Methods are described for controlling phragmites, cattails, needlerush, waterchestnut, and waterhyacinth. Results of preliminary studies are described for alligatorweed and Eurasian watermilfoil. [Herbicides included are 2,4-D, MCPA, silvex, amitrol, and dalapon.] (Author's summary)

Citation Number 319
Steenis, J. H., and J. Warren. 1969. Management of needlerush for improving waterfowl habitat in Maryland. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners13: 296-298.

Needlerush, one of the most prominent plants of the southern coastal marshes, dominates an area of about 600,000 acres. Studies in Maryland showed that derivatives of 2,4-D, particularly 2,4-D acetamide, provide the most effective, economical control. Continuous flooding of treated areas prevents reinvasion of needlerush. Marshes dominated by needlerush can be improved for waterfowl by flooding and herbicidal treatments that create an interspersion of marsh and open water suitable for the growth of submerged food plants. (Authors' summary)

Citation Number 320
Steuter, A. A. 1978. Response of wildlife to brush control in the Rio Grande Plain. M.S. Thesis, Texas Tech University, Lubbock. 49pp.

[The effects of brush control on wildlife habitat was described on 12 areas in the Rio Grande Plain of Texas. Treatments included herbicide (Tordon 225), herbicide and burn, and a 20-year-old rootplowed area. Herbicide alone slightly decreaseed live brush density but did not affect horizontal vegetation density 2 years after treatment. Herbicide and burning decreased brush cover and horizontal vegetation significantly. Grass cover on both herbicide treatments was greater than on control sites. Call counts of bobwhite quail were higher on both herbicide treatments than on untreated areas. Coyote activity was highest on the sprayed and burned areas. Deer densities were correlated positively with percent brush cover.] (KVM abstract)

Citation Number 321
Stone, A. E. 1986. Effects of tebuthiuron site preparation on seed and invertebrate availability for birds in Georgia hardwood-southern pine forests. M.S. Thesis, University of Georgia, Athens. 70pp.

Seeds and invertebrates were collected during June and September 1985 from 1 study site in the Piedmont Plateau and 1in the Coastal Plain of Georgia. These areas were treated with the soil-active herbicide tebuthiuron (Graslan 60P) in January 1984, before planting loblolly pine (*Pinus taeda*) in December 1984 and January 1985. Additional seed and invertebrate collections were made from on-site untreated (control) areas. ... Results included greater graminoid seed biomass in September on treated vs. control areas on both sites, and lower invertebrate availability overall on the Piedmont Plateau site. General management recommendations are made for tebuthiuron use on these sites based on published literature regarding birds and bird food habits. (Author's abstract)

Citation Number 322
Strode, D. D. 1957. A preliminary report of the effects of the T. S. I. program on the wildlife habitat in the Ocala National Forest. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 10:59-68.

[This study was conducted to determine the effects of the TSI program in the longleaf pine areas of the Ocala National Forest on game habitat. The TSI work consisted of either girdling and poisoning (2,4,5-T) or cutting and poisoning undesirable commercial species. Results indicate that the TSI program has hurt the wildlife habitat in certain areas but has possibly helped in others depending on whether it is conducted in a heavy oak stand or in a thin stand. Recommendations for coordinating wildlife habitat needs with TSI programs are presented.] (KVM abstract)

Citation Number 323
Sullivan, T. P., and D. S. Sullivan. 1979. The effects of glyphosate herbicide on food preference and consumption in black-tailed deer. Canadian Journal of Zoology 57:1406-1412.

The use of herbicides is an important part of forestry management practices in the Pacific Northwest because the regeneration of coastal forests is hampered by many species of deciduous shrubs and weeds. The herbicide glyphosate is used to control these undesirable species. Some effects of glyphosate on black-tailed

deer have been investigated by analyzing food preference and consumption under simulated field conditions. Deer given a choice of control or glyphosate-treated alder and alfalfa browse showed no preference and ate more of the treated foliage. The ingestion of treated browse did not affect the consumption of labratory chow by the deer. These results indicate that spraying with the herbicide glyphosate should not prevent deer from feeding on foliage in the affected area.
(Authors' abstract)

Citation Number 324
Sullivan, T. P., and D. S. Sullivan. 1981. Responses of a deer mouse population to a forest herbicide application: reproduction, growth and survival. Canadian Journal of Zoology 59:1148-1154.

This study was designed to monitor some of the demographic responses of a deer mouse population to a forest application of Roundup herbicide. Populations of *Peromyscus maniculatus* were livetrapped from July 1978 to November 1980 on a control area and in a herbicide-treated 20-year-old Douglas-fir plantation at Maple Ridge, British Columbia. The herbicide had no apparent adverse effects on reproduction, growth, or survival of deer mice 1 year after treatment. Inconsistencies in growth rates and juvenile survival between control and experimental deer mice in 1980 could be due to the herbicide or demographic factors. Field dose applications of this herbicide should not have a direct effect on the dynamics of deer mouse populations. (Authors' abstract)

Citation Number 325
Sullivan, T. P., and D. S. Sullivan. 1982. Response of small mammal populations to a forest herbicide application in a 20 year old conifer plantation. Journal of Applied Ecology 19:95-106.

(1) The response of small-mammal populations to a forest application of Roundup herbicide have been investigated at the University of British Columbia Research Forest, Maple Ridge, B.C., Canada. (2) These populations included the deer mouse, Oregon vole, Townsend chipmunk, and shrews. (3) Treatment of a 20-year-old Douglas fir plantation did not have any negative effects on the distribution and abundance of small-mammal populations during the first year. ... (4) ... There was not an influx of new animals from the surrounding regions onto the treated area nor was there a significant movement of marked animals away from the sprayed area. (5) Future changes in composition of the small-mammal community may occur in association with successional stages advancing from the herbicide-induced habitat alteration. (Authors' summary)

Citation Number 326
Sullivan, T. P. 1985. Effects of glyphosate on selected species of wildlife. Pp. 186-199 *in* E. Grossbard and D. Atkinson, eds. The Herbicide Glyphosate. Butterworths Publishing Company, Boston, Mass.

Studies on food preference and habitat use by black-tailed deer indicate that these animals will consume glyphosate-treated foliage and occupy treated habitats. If the nutritional content of dying foliage is not greatly reduced, and there are no adverse effects of glyphoste on the physiology of deer, then these animals should be able to feed successfully within a sprayed area. ... The long-term effects of glyphosate on deer and related ungulatesare not known. ... Glyphosate did not have any negative effects on the distribution and abundance of small mammal populations, at least during the first year after habitat alteration. ... Herbicides such as glyphosate, through alteration of vegetation, can modify the density, habitat use and foraging behaviour of nesting birds. ... (Author's conclusions)

Citation Number 327
Sullivan, T. P., and E. J. Hogue. 1987. Influence of orchard floor management on vole and pocket gopher populations and damage in apple orchards. Journal of the American Society for Horticultural Science 112:972-977.

Removal of all vegetation with herbicides over the total orchard floor or only in tree rows significantly reduced montane vole (*Microtus montanus* Peale), meadow vole (*M. pennsylvanicus* Ord), and northern pocket gopher (*Thomomys talpoides* Richardson) populations and damage. Herbicide treatments in four test orchards were carried out during May, July, and Sept. 1983 to 1985. Average overwinter abundance of voles was reduced 53% to 99% on treatment areas. Several vole populations went to extinction in the third year of herbicide treatment. ... Pocket gopher populations and damage were significantly lower in treatment than control blocks. Deer mouse (*Peromyscus maniculatus* Wagner) and yellow pine chipmunk (*Eutamias amoenus* J.A. Allen) populations generally increased on treated areas. Use of herbicides to control orchard floor vegetation is an effective means of rodent damage control. (Authors' abstract)

Citation Number 328
Sullivan, T. P. 1988. Non-target impacts of the herbicide glyphosate. Mammal Pest Management Ltd., Information Report. 43pp.

[A compendium of references and abstracts is provided on the non-target impacts of glyphosate. Sections include both direct and indirect effects of glyphosate on mammals, birds, fish, aquatic invertebrates and algae, terrestrial invertebrates, and microflora.] (KVM abstract)

Citation Number 329
Sullivan, T. P. 1990. Influence of forest herbicide on deer mouse and Oregon vole population dynamics. Journal of Wildlife Management 54:566-576.

[This study] investigated the direct effects of a forest application of glyphosate herbicide on recruitment, growth, and survival in deer mice (*Peromyscus maniculatus*) and Oregon voles (*Microtus oregoni*) by comparing populations in control and treatment habitats [near Maple Ridge, British Columbia, Canada]. Recruitment of deer mice declined during the first post-spray summer and winter, but increased on the treatment area in subsequent years. Generally, there was little difference in recruitment of Oregon voles between control and treatment areas; survival of animals was similar on control and treatment areas. However, female voles did survive significantly ($P < 0.05$) better on the treatment than on the control area in the post-spray summer 1982 and winter of 1982-83. Lack of consistent differences in body mass and growth rates of deer mice and voles between control and treatment areas during post-spray periods indicated that glyphosate had little or no direct effect on metabolic or general physiological processes in the development of young animals. The manifestation of physiological changes in individual animals that might have resulted from exposure to or ingestion of glyphosate was not apparent in demographic attributes at the population level. (Author's abstract)

Citation Number 330
Sullivan, T. P. 1990. Demographic responses of small mammal populations to a herbicide application in coastal coniferous forest: population density and resiliency. Canadian Journal of Zoology 68:874-883.

This study was designed to assess the demographic responses of small mammal populations to herbicide-induced habitat alteration in a 7-year-old Douglas fir (*Pseudotsuga menziesii*) plantation near Maple Ridge, British Columbia, Canada. Populations of the deer mouse (*Peromyscus maniculatus*), Oregon vole (*Microtus oregoni*), Townsend chipmunk (*Eutamias townsendii*), and shrews (*Sorex* spp.) were sampled in control and treatment habitats from April 1981 to September 1983 and from April to October 1985. Recolonization of removal areas by these species was also monitored in both habitats. There was little

difference in abundance of deer mice, Oregon voles, and shrews between control and treatment study areas. Chipmunk populations appeared to decline temporarily on the treatment areas relative to controls. Recolonization by voles was not affected by habitat change, but for deer mice was lower on the treatment than control area. Both deer mouse and Oregon vole populations were at comparable densities on control and treatment areas in the second and fourth years after herbicide treatment. The proportion of breeding animals and average duration of life were similar in control and treatment populations of deer mice and voles. These small mammal species should be able to persist in areas of coastal coniferous forest which are treated with glyphosate for conifer release. (Author's abstract)

Citation Number 331
Sullivan, T. P. 1994. Influence of herbicide-induced habitat alteration on vegetation and snowshoe hare populations in sub-boreal spruce forest. Journal of Applied Ecology 31:717-730.

This study was designed to test the hypothisis that herbicide-induced [glyphosate] habitat alteration would reduce snowshoe hare (*Lepus americanus*) populations in early-to mid-successional (<25 years post-treatment) stages of sub-boreal spruce forest. Intensive population sampling and monitoring of vegetation were conducted in replicate control and treatment blocks near Prince George, British Columbia, Canada from 1988 to 1991. Index line surveys of hares also were conducted in 10 paired control-treatment blocks. Herb biomass and cover recovered to control values by 2-3 years post-treatment. Shrub and tree biomass and cover were little affected in a 'conifer release' treatment where coniferous species dominated these layers. In a 'backlog conversion' treatment, the dominant deciduous trees and shrubs were relatively slow to recover. Herbicide-induced habitat alteration in optimum habitat seemed not to affect abundance of snowshoe hares during summer and autumn. Post-harvest habitats 10-20 years of age may have sufficient and persistent vegetative structure, particularly those with a high component of coniferous species, to support hare populations regardless of herbicide treatment. (Author's summary)

Citation Number 332
Sullivan, T. P., R. A. Lautenschlager, and R. G. Wagner. 1995. Changes in diversity of plant and small mammal communities after herbicide application in sub-boreal spruce forest. Pp. 143-145 *in* R. E. Gaskin and J. A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

This study evaluated changes in species diversity of plant and small mammal communities to herbicide application [glyphosate] for conifer release in sub-boreal spruce forest. There were no differences in number of plant species between control and treatment blocks in the herb (5-year-old) successional stage, but shrub species richness declined in the shrub (10-year-old) successional stage. There were no differences in diversity of herbs throughout the study. Diversity of shrubs was lower in post-treatment than control blocks in both successional stages, but primarily in the first two years after treatment. Species diversity of small mammal communities was not affected. Except for a temporary decline in shrub richness and diversity, these treatment blocks should not lower overall diversity of a forested landscape. (Authors' summary)

Citation Number 333
Sullivan, T. P., and L. W. Taylor. 1995. Wildlife habitat enhancement with eject in stand thinning of lodgepole pine. Pp. 310-312 *in* R. E. Gaskin and J. A. Zabkiewicz, compilers. Second International Conference on Forest Vegetation Management, Rotorua, New Zealand. New Zealand Forest Research Institute Bulletin Number 192.

This study is determining the responses of understory vegetation and small mammal communities to stand thinning of lodgepole pine (*Pinus contorta*) by conventional cutting and by Ezject® (injection herbicide capsules). These two techniques may have substantial effects on understory vegetation, in terms of light and

debris on the forest floor. This will likely affect wildlife and also quality of forage for livestock using forests as summer range. (Authors' summary)

Citation Number 334
Sweeney, S. W., T. B. Wigley, J. R. Sweeney, and D. H. Van Lear. 1993. Forestry, wildlife, and habitat in the east (an annotated bibliography), 1986-1990. National Council of the Paper Industry for Air and Stream Improvement, Technical Bulletin 651. 317 pp.

[This annotated bibliograpy contains published information describing relationships between forest management activities (including the use of herbicides) and wildlife habitats and communities in the eastern United States, emphasizing publications containing results from field studies. Each citation is accompanied by an abstract and keywords.] (DLH summary)

Citation Number 335
Tanner, G. W., J. M. Inglis, and L. H. Blankenship. 1978. Acute impact of herbicide strip treatment on mixed-brush white-tailed deer habitat on the northern Rio Grande Plain. Journal of Range Management 31:386-391.

White-tailed deer tended to evacuate a 1,800-ha, mixed-brush pasture during 5 months following aerial strip-spraying in May with 2,4,5-T + picloram (1:1) at 0.56 kg/ha and 1.12 kg/ha and in two widths (80% coverage). Deer were attracted to the pasture in above-normal numbers the following winter but their numbers returned to normal by 11 months posttreatment. Apparently, succulent woody plant regrowth provided an attractive food base which induced the posttreatment increase in numbers. Deer on the pasture did not rearrange their use to favor untreated brush as a response to treatment rate or width of treated strip. Woody plant canopy cover was significantly reduced on all treated strips but cover screen at deer height was unaffected. Evidence suggests that only the high rate of herbicide application resulted in significant reduction in the stature of brush. Density of live brush stems was reduced less than 20% by treatment. (Authors' abstract)

Citation Number 336
Terry, T. A., R. F. Lowery, G. A. Hurst, and R. C. Warren. 1986. Meeting herbaceous weed control objectives in loblolly pine plantations - the rolling coastal plain. Proceedings of the Southern Weed Science Society 39:195.

Herbaceous weed control programs in young plantations [in Mississippi] must strive to: (1) reduce herbaceous competition to a level that economically improves plantation survival and growth, (2) maintain vegetative cover adequate to prevent significant soil erosion, (3) provide adequate food and cover for important wildlife species, and (4) be otherwise environmentally acceptable. ... Preferred deer forage levels on treated areas are similar to nontreated areas three years after broadcast applications of Velpar-L and forb levels increase somewhat over those found in control areas. ... (Authors' abstract)

Citation Number 337
Tharp, J. E. 1971. A study of scaled and bobwhite quail with special emphasis on habitat requirements and brush control. M.S. Thesis, Texas Tech University, Lubbock. 58pp.

The effects of brush control on bobwhite and scaled quail habitat was studied on 14 study areas in 7 vegetation types. The effects of brush control varied with the type of habitat, amount of preferred canopy cover existing before and after treatment, amount of grass cover, and species of quail. The author concluded that [in regard to herbicide spraying, brush control as currently practiced may be resulting in better quail habitat generally by encouraging sprouting of mesquite which results in low cover better suited to quail than tall mesquite.] (KVM abstract)

Citation Number 338

Thomas, J. D., and E. Buckner. 1980. Re-establishing yellow pine habitat for the red cockaded woodpecker on the Cumberland Plateau. Pp. 358-361 *in* Proceedings of the First Biennial Southern Silvicultural Research Conference. United States Department of Agriculture, Forest Service, General Technical Report SO-34.

Developing inexpensive silvicultural systems for increasing the pine component of forests on the Cumberland Plateau is essential for maintaining a population of red-cockaded woodpeckers in that area. Site preparation and hardwood control techniques considered feasible and acceptable on the Catoosa Wildlife Management Area were tested; these included: (1) burning, (2) fire plowing, (3) drum chopping, and (4) a velpar treatment. ... The effectiveness of the hardwood control treatments was evaluated by recording for each planting "spot" the likelihood that an extablished pine seedling ... would outgrow hardwood competition. Both fire plowing and drum chopping significantly reduced hardwood competition. (Authors' abstract)

Citation Number 339

Thompson, M., R. Umber, M. Shaw, J. Skeen, and R. Thackston. 1989. Herbicide and burning effects on overstory defoliation and understory production on Cookson Hills Wildlife Management Area. Annual Meeting of the Southeast Deer Study Group, Oklahoma City 12:19.

Overstory defoliation and understory annual production were evaluated to test the effectiveness of 3 herbicides (picloram, hexazinone, and tebuthiuron) and controlled burning in providing openings and increasing white-tailed deer (*Odocoileusvirginianus*) forage in an oak-hickory forest in northeastern Oklahoma. ... Overall, single-tree injection of picloram was the most effective in defoliating trees. Hand broadcast hexazinone pellets were most effective in defoliating trees on ridgetops. Tebuthiuron overstory kill was not significantly different than that of the control. Burning improved kill efficacy by 71% and increased forb and grass production. Aerial application of tebuthiuron and burning produced the most grass while picloram injection combined with burning produced the greatest biomass of forbs. Picloram injection effected the best overall kill of the overstory and provided the best deer forage in terms of quality, abundance, and sustained yield. (Authors' abstract)

Citation Number 340

Thompson, M. W., M. G. Shaw, R. W. Umber, J. E. Skeen, and R. E. Thackston. 1991. Effects of herbicides and burning on overstory defoliation and deer forage production. Wildlife Society Bulletin 19:163-170.

[The authors] evaluated the effectiveness of 3 herbicides (Tordon, Velpar, and Graslan) and controlled burning in providing openings and increased deer forage in an oak/hickory forest in northeastern Oklahoma. ... Tordon injection was most effective in defoliating trees. Hand broadcast Velpar pellets produced the highest defoliation on ridgetops. Burning improved overstory kill ... and increased standing biomass of forbs and grasses. All herbicides significantly increased forb biomass, but only aerially applied Graslan increased biomass of grasses. Deer forage availability was improved by canopy reduction, and the forb component was enhanced most where Tordon injection was combined with burning. ... (Authors' summary)

Citation Number 341

Thompson, R., and C. Kabat. 1956. Herbicides for creating wildlife food patches. Proceedings of the North Central Weed Control Conference 13:26-27.

[Two bluegrass and 2 quackgrass areas were experimentally sprayed with dalapon (8 lb ai/ac) as a means of eliminating competition in sod-bound soil by pre-planting treatment. Results indicate that dalapon gave sufficient sod control for 1 growing season when applied to grass 4+ inches high. Bluegrass is more completely controlled than quackgrass.] (KVM abstract)

Citation Number 342
Tietjen, H. P., C. H. Halvorson, P. L. Hegdal, and A. M. Johnson. 1967. 2,4-D herbicide, vegetation, and pocket gopher relationships, Black Mesa, Colorado. Ecology 48:634-643.

In a 7-year study on Black Mesa, Colorado, elevation 10,000 ft, 2,4-D herbicide treatment initially reduced forb abundance and northern pocket gopher (*Thomomys talpoides*) populations 80% to 90%. Both forbs and pocket gophers remained at low levels on one area but returned to pretreatment levels on the other area. The decline in pocket gopher numbers was caused by an inability to survive where their preferred food (forbs) was eliminated by herbicide treatment. The decline was not caused by movement of the animals from sprayed areas, or by direct or indirect toxicity of 2,4-D. The common grasses offer, at best, only marginal diet for northern pocket gophers; only succulent grasses or those bearing corms or rhizomes yield a subsistence diet. Limited sampling did not indicate that the spray treatment affected the numbers of other small mammals. (Authors' abstract)

Citation Number 343
Torrey, D. S., and C. M. Kirkpatrick. 1980. Pre- and post-treatment results of aquatic herbicide application at Purdue Wildlife Area. Proceedings of the Indiana Academy of Science 89:145-146.

[To preserve waterfowl habitat and increase waterfowl use, a pond on Purdue Wildlife Area, near West Lafayette, Indiana was sprayed with Aquathol in June 1977. Results indicate that the herbicide had an effect on the aquatic vegetation, waterfowl, and aquatic invertebrates. Although there was no increase in the number of diving ducks, they appeared to dive more and increased their time at the area after the herbicide application. The number of dabbling waterfowl declined posttreatment. Studies of muskrat house composition suggest that they were not affected by the reduction of submerged aquatic vegetation. Aquatic herbicides may be an effective tool for preserving waterfowl habitat in that it inhibits the natural plant succession that would eventually replace the aquatic environment.] (KVM abstract)

Citation Number 344
Trumbo, H. A., and W. E. Chappell. 1960. Techniques involved in the use of chemicals for establishing wildlife clearings. Proceedings of the Northeastern Weed Control Conference 14:454-459

It is apparent that fenuron and monuron are the most effective herbicides for killing a greater proportion of the tree species; fenuron being more desirable because quicker results are obtained. ... A considerable number of annual and perennial plants invaded these areas during the first growing season after treatment. ... Due to the great number of sprouts produced by the use of Ammate [it] might be used to produce browse in areas where it is desired. ... The use of 2,4,5-T in spaced axe-cut frills is not a satisfactory method of creating an opening ... Herbicides as a wildlife management tool shows great promise for creating wildlife clearings and controlling undesirable tree and shrub species ... (Authors' summary)

Citation Number 345
Trumbo, H. A., and W. E. Chappell. 1961. Techniques involved in the use of chemicals for establishing wildlife clearings. Proceedings of the Annual Conference of the Southeastern Association of Game and Fish Commissioners 13:34-38.

Same paper as Trumbo and Chappell (1960).

Citation Number 346
Turrentine, J. M. 1970. The ecology of bobwhite quail in aerially sprayed sand shinnery oak habitat. M.S. Thesis, Texas Tech University, Lubbock. 83pp.

[The effect of aerial herbicide treatment of sand shinnery oak on bobwhite quail habitat was studied on 7 areas in the Texas Panhandle. Both sprayed and unsprayed areas had adequate cover to maintain quail

populations throughout the year with the exception of the 'no brush' area which had quail use only along edges near pastures containing brush. Dead stems provided cover until the oaks regrew. To insure adequate cover, portions of an area should remain untreated. Distance between brush strips probably should not exceed 400 yards.] (KVM abstract)

Citation Number 347
Urness, P. J. 1966. Influence of range improvement practices on composition, production, and utilization of Artemisia deer winter range in central Oregon. Ph.D. Dissertation, Oregon State University, Corvallis. 195pp.

... The objectives of this study were to evaluate the impact of various sagebrush control practices [including the use of herbicides] on the composition, production, and utilization of deer forage plants during the critical winter period [in Lake County, Oregon during 1963 through 1965]. ... It was concluded that effects of existing improvement programs were usually minor compared with the declining condition of the all-important bitterbrush stands resulting from excessive winter populations of deer. ... Seeding and other range improvements tended to create a diversified plant cover and forage resource that appeared to enhance the use of the untreated sagebrush. ... (Author's abstract)

Citation Number 348
Vallentine, J. F. 1983. The application and use of herbicides for range plant control. Pp. 39-48 *in* S.B. Monsen and N. Shaw, compilers. Managing Intermountain Rangeland-Improvement of Range and Wildlife Habitats. United States Department of Agriculture, Forest Service, General Technical Report INT-157.

[Herbicides are an effective, necessary, and environmentally sound tool for the control of weeds and brush on rangelands to enhance livestock and big game forage availability. Various herbicide application methods and safety precautions are discussed. The properties and rangeland/pasture uses of 15 herbicides is presented in tabular form. Uses of amitrole, atrazine, dalapon, dicamba, 2,4-D, fenac, glyphosate, karbutilate, paraquat, picloram, silvex, 2,4,5-T, 2,3,6-TBA, tebuthiuron, and triclopyr in range management are discussed.] (KVM abstract)

Citation Number 349
VanEtten, R. C. 1959. Ecological changes in sharp-tailed grouse habitat resulting from an aerial application of 2,4-D. Michigan Department of Conservation Report 2256. 6pp.

Spraying a 300-acre area in Michigan's Upper peninsula from the air with 2,4-D to improve sharp-tailed grouse habitat produced marked ecological changes. ... Some ground cover shrubs and herbaceous plants showed temporary injury, but most regained at least their former abundance after 3 years. Many open-growing species increased noticeably as a result of removal of the overstory, and several new plants appeared. Some of these furnish new grouse foods. The herbicidal treatments may have been too complete, since it failed to leave edges for food and cover. Possibly [they] should leave strips unsprayed in the future. Few sharptails used the area until several years after treatment. (Author's summary)

Citation Number 350
VanEtten, R. C. 1959. Effectiveness of the herbicides silvex and PBA in controlling deciduous trees and shrubs. Michigan Department of Conservation Report 2258. 3pp.

[Various concentrations of silvex and PBA were tested to determine their effectiveness on deciduous trees, especially sugar maple. Silvex produced better kills of vegetation than any of the PBA tests. Apparently 1 lb/ac of silvex was too light to give the desired kill. Regeneration in most species was prolific, regardless of concentration. Juneberry, a good wildlife food plant, withstood mixtures of up to 4 pounds per acre of silvex.] (KVM abstract)

Citation Number 351
VanEtten, R. C., and I. Thomson. 1959. The value of silvex in creating openings in maple-aspen stands. Michigan Department Conservation Report 2257. 7pp.

Aerially spraying 2.3 lbs/ac of silvex on a 24-acre strip of mixed aspen and maple to improve ruffed grouse habitat created some openings in the canopy. It failed to kill most of the dominant aspen and maple, and encouraged sprouting of the aspen. ... habitat improvement will be of limited duration without additional herbiciding. ... Most open-growing herbaceous plants were increasing as a result of opening of the canopy, and several new species had entered the area. The spray produced large amounts of nutritious deer browse, utilized heavily by the deer. In some instances this additional deer food may be as important to game management as the openings created. ... (Authors' summary)

Citation Number 352
Wadsworth, C. E. 1970. The effects of herbicide applications on the animal populations of aspen communities. Ph.D. Dissertation, Brigham Young University. 109pp.

Approximately 475 acres of aspen, oak brush, and grass-forb-shrub communities were treated with herbicides [2,4-D and 2,4,5-T]. ... Bird populations were lower in the treated area during the nesting season (June), higher in the treated area during July and August and nearly the same in each area during September. Small mammal populations decreased significantly on the treated meadow plots. *Microtus* populations increased while all other small mammals decreased in numbers on treated aspen plots. Use of the treated area by mule deer was reduced, while use of the same areas by elk was slightly increased. (Author's abstract)

Citation Number 353
Wallestad, R. 1975. Male sage grouse responses to sagebrush treatment. Journal of Wildlife Management 39:482-484.

Male sage grouse (*Centrocercus urophasianus*) populations on six central Montana strutting grounds were studied in relation to sagebrush (*Artemisia tridentata*) treatment [2,4-D or mechanical]. Populations on 3 strutting grounds within 0.5 km of treated areas increased 28 percent, whereas 2 grounds farther than 4 km from treated areas increased 323 percent. Over a 2-year period, a 31 percent loss of suitable habitat within 0.5 km of another strutting ground resulted in a 63 percent decrease in numbers of strutting males. (Author's abstract)

Citation Number 354
Warbach, O. 1953. Control of Japanese honeysuckle in wildlife borders. Journal of Wildlife Management 17:301-304.

Japanese honeysuckle, an exotic that can be either a pest or an asset in different localities, makes maintenance of wildlife plantings in the Southeast a difficult problem. A herbicide applied during the winter and strong enough to kill dormant woody plants will stop the spread of honeysuckle from a woods edge for a least 2 years. A low-percentage 2,4-D water spray applied to honeysuckle growing in bicolor lespedeza borders at a time when honeysuckle is starting growth and bicolor is still dormant will selectively destroy the vine without injuring the border. (Author's summary)

Citation Number 355
Ward, A. L. 1973. Sagebrush control with herbicide has little effect on elk calving behavior. United States Department of Agriculture, Forest Service, Research Note RM-240. 4pp.

Elk did not change their calving behavior or feeding habits on a site where 96.7% of the big sagebrush (*Artemisia tridentata*) cover had been killed with 2 pounds acid equivalent of 2,4-D herbicide. (Author's abstract)

Citation Number 356
Warren, R. C. 1980. Food abundance, plant rating, and track counts for white-tailed deer; effects of control burning pine plantations; avian populationsin pine plantations site prepared by mist-blowing and tree-injection; and acorn production and squirrel population estimates in the mixed pine-hardwood forest type of east-central Mississippi. M.S. Thesis, Mississippi State University, Mississippi. 791pp.

[In addition to other results, the author reports on the effect that mist-blowing/injection (2,4,5-T and 2,4-D) site preparation has on avian populations. The deer habitat responses to type of site preparation and plantation age are also discussed.] (KVM abstract)

Citation Number 357
Warren, R. C., G. A. Hurst, and T. L. Darden, Jr. 1984. Relative abundance of cavity nesting birds on pine plantations site prepared by herbicides. Pp. 197-205 *in* W.C. McComb, ed. Proceedings of the Workshop on Management of Nongame Species and Ecological Communities, University of Kentucky, Lexington.

Coefficients of detectability were calculated for cavity nesting species observed on variable width transects in 3 loblolly pine (*Pinus taeda*) plantations [2 to 8 years-old] in east central Mississippi. After clearcutting, the areas had been site prepared by mist-blowing (2,4,5-T) followed by tree-injecting (2,4-D), which created much logging debris and many snags. ... In the spring, 9-13 species were found on the plantations with the highest number at ages 2-5 years. In the winter there were 10-15 species observed. Total cavity nester abundance in the spring was lowest at plantation age 2 and highest at age 4, but remained comparatively high at age 8. [The abundant primary and secondary cavity nesters are listed and the effects of plantation age on these species is described.] (Authors' abstract)

Citation Number 358
Watkins, R. M., R. A. Beardmore, and M. H. Johnston. 1989. Arsenal applicators concentrate for loblolly pine release: Three-year results of rates and timings of hardwood control. Proceedings of the Southern Weed Science Society 42:225.

Vegetative responses were studied in 2 loblolly pine (*Pinus taeda*) plantations in east-central Mississippi following Arsenal applications made in July and October 1985. ... Arsenal treatments were 0.75 without surfactant, 0.5, 0.75, and 1.0 pounds a.i./acre with surfactant. ... The species transition following Arsenal applications benefited wildlife habitat, with greater and more desirable preferred wildlife food cover. Grasses and wood plants decreased in the treatment plots, while forbs and vines increased. Legume plants increased in the treated plots, especially *Lespedeza* species. (DLH abstract)

Citation Number 359
Welling, C. H., and R. L. Becker. 1993. Reduction of purple loosestrife establishment in Minnesota wetlands. Wildlife Society Bulletin 21:56-64.

The objective was to determine whether establishment of purple loosestrife [an exotic perennial, emergent plant which can displace native vegetation, thereby reducing use of wetlands by some species of wildlife] through recruitment from seed banks can be reduced by use of either 2,4-D herbicide or competitor plant species. These approaches were evaluated with soil collected from 2 Minnesota wetlands and maintained in outdoor flats where water levels were controlled. In flats, application of 2,4-D to seedling communities reduced loosestrife frequency and population density ... Application of 2,4-D also reduced dicot species richness. In flats, seeding of Italian ryegrass reduced loosestrife density ... in 1 but not both years of the study; seeding Japanese millet did not reduce loosestrife seedling density. In wetlands where water levels were uncontrolled, 2,4-D applied to field quadrats reduced loosestrife seedling density ... and also reduced both biomass of dicots other than loosestrife and dicot species richness ... Competitors failed to establish in field quadrats and consequently had no effect on seedling establishment in study wetlands. Because it is

difficult to reduce loosestrife establishment, managers should minimize seed bank development by attempting to eliminate recently established populations of scattered plants before they attempt to control long-established, monodominant stands. Application of treatments to reduce loosestrife establishment also may alter establishment of other plants, the desirability of which will depend on management objectives. (Authors' summary)

Citation Number 360
Whitford, W. G., and Y. Steinberger. 1989. The long-term effects of habitat modification on a desert rodent community. The Museum, Texas Tech University, Special Publication Number 28:33-44.

[Data are presented from the results of a 14-year study of changes in composition of a desert rodent community in New Mexico following habitat perturbations. The authors studied rodent populations in an area where herbicide (dicamba) treatment reduced shrub cover and increased grass cover. In the first two years following the herbicide treatment, the rodent community structure changed. *Dipodomys ordii* replaced *D. merriami* as the most abundant large heteromyid on the areas that had increased grass cover and decreased shrub cover. However, within four years after herbicide treatment, *D. merriami* was more abundant than *D. ordii* in both the grass and shrub habitats.] (DLH abstract)

Citation Number 361
Whitson, R. E., S. L. Beasom, and C. J. Scifres. 1977. Economic evaluation of cattle and white-tailed deer response to aerial spraying of mixed brush. Journal of Range Management 30:214-217.

The combined economic effects, based on returns for lease hunting of white-tailed deer in conjunction with livestock production, were calculated following partial treatment (80% sprayed in alternating strips) and complete treatment of mixed brush in South Texas with aerial sprays of 2,4,5-T and picloram at 1 lb/acre. Both approaches were economically feasible based on a 10% discount rate over a 9-year projected treatment life, except when the brush was completely sprayed and cattle prices were $0.255/lb. However, when cattle prices were less than $0.495/lb, partial treatment by aerial spraying was preferred, in an economic sense, since returns from lease hunting where 20% of the brush was left untreated for wildlife habitat more than compensated for reduced cattle returns. (Authors' abstract)

Citation Number 362
Wiens, J. A., and J. T. Rotenberry. 1985. Response of breeding passerine birds to rangeland alteration in a North American shrubsteppe locality. Journal of Applied Ecology 22:655-668.

During 1980, a large area of sagebrush (*Artemisia tridentata* Nutt.)-dominated rangeland in southern Oregon, USA was sprayed with the herbicide 2,4-D, the dead shrubs removed, and crested wheatgrass (*Agropyron crisatum* (L.)) planted. ...[They] monitored breeding bird populations in the treated area for 3 years prior to and 3 years following the alteration. ... There was no evidence of an immediate response by the bird populations to these habitat changes. In the year following the treatment, abundances of sage sparrows (*Amphispiza belli* (Cassin)) did not change, while the density of Brewer's sparrows (*Spizella breweri* Cassin) decreased. ... The failure of such bird populations to respond rapidly to major habitat changes may relate to time lags produced by site tenacity of breeding individuals. Such time lags complicate attempts to formulate policies on the basis of short-term before and after surveys. ... (Authors' summary)

Citation Number 363
Wilbert, D. E. 1963. Some effects of chemical sagebrush control on elk distribution. Journal of Range Management 16:74-78.

[The effect of chemical control (2,4-D) of big sagebrush (*Artemisia tridentata*) on the spring distribution of elk was evaluated by treating two 25 acre plots in Teton Co., Wyoming. Wildlife use was

determined by actual animal sighting, and by intensive pellet group counts. The treatments had striking effects on distribution of game animals. All data gathered indicate that the treated areas provided a definite attraction for the elk, especially in the late spring. These data would indicate that manipulation of sagebrush range offers possibilities as a practical tool to aid in the distribution of elk in the spring.] (KVM abstract)

Citation Number 364
Wilkins, R. N. 1992. Changes in vegetation following site preparation and understory restoration with the forest herbicide hexazinone. Ph.D. Dissertation, University of Florida, Gainesville. 120pp.

[Changes in forest plant communities following applications of hexazinone were evaluated with tree studies: (1) rate-response experiments on 3, one-year-old clearcuts, each representing a point along a generalized moisture-stress gradient; (2) comparisons of hexazinone and mechanically (shear and windrow) site prepared loblolly pine (*Pinus taeda*) plantations established 7 years earlier on hydric hammock sites; and (3) rate-response experiments for understory restoration of a successfully-advanced, xeric sandhill site. Plant community responses to hexanzione are functions of application rate, edaphic factors, adaptive strategies of resident species, and the presence-absence of hexazinone tolerant species. The data suggest that hexazinone application (relative to shear and windrow) is the more desirable site preparation technique when considering the needs of a wide variety of vertebrate wildlife species.] (DLH abstract)

Citation Number 365
Wilkins, R. N., G. W. Tanner, W. R. Marion, D. G. Neary. 1992. Plant diversity 7 years after chemical and mechanical site preparation on hydric hammock sites. Proceedings of the Southern Weed Science Society 45:228.

[Woody vegetation within four loblolly pine (*Pinus taeda*) plantations, converted from hydric hammock forest, was sampled at age 7 in the Gulf Hammock area of Levy County, Florida to quantify differences in plant composition and diversity due to mechanical (KG-blade and windrowing) and chemical (hexazinone) site preparation treatment. Differences in several wildlife food plants among treatments are discussed. Foliar cover by all members of the grape family (Vitaceae) was 3 to 4 times greater on mechanical treatments; while foliar cover by cabbage palm (*Sabal palmetto*) and *Smilax* spp. was 3 to 4 times greater on hexazinone treatments. Grape cover on mechanical treatments was concentrated on windrows, while wax-myrtle (*Myrica cerifera*) and yaupon (Ilex vomitoria) avoided windrows.] (DLH abstract)

Citation Number 366
Willig, M. R., R. L. Colbert, R. D. Pettit, and R. D. Stevens. 1993. Response of small mammals to conversion of a sand shinnery oak woodland into a mixed-grass prairie. Texas Journal of Science 45:28-43.

Shrubs were removed in two areas of a sand shinnery oak woodland via the aerial application of tebuthiuron, an herbicide that eliminates at least 90 percent of the shrub component (*Quercus havardii*). ... Estimates of density (total rodents and [Ord's kangaroo rat] *Dipodomys ordii* alone) ... were obtained for each area during each of four phenological seasons. Habitat variables ... were determined for tebuthiuron treated and control sites. ... Both total rodent density and *D. ordii* density changed in response to tebuthiuron-related effects. Species composition (proportional species densities) also differed significantly between treated and untreated areas. Seasonal effects on density and species composition occurred and probably were related to behavioral responses of rodents to temperature and precipitation regimes. (Authors' abstract)

Citation Number 367

Witt, J. S., A. S. Johnson, K. V. Miller, P. M. Dougherty, and P. B. Bush. 1990. Responses of wildlife food plants to herbicide site preparation in the Georgia Piedmont. Proceedings of the Southern Weed Science Society 43:201.

Field measurements were conducted on 3 loblolly pine (*Pinus taeda*) plantations in summer 1988 to evaluate the response of wildlife food plants to various mechanical [shear and rake] and chemical [imazapyr, triclopyr, picloram + triclopyr, and hexazinone] site preparation treatments at 2-4 years post-treatment. ... Preliminary examination of mean percent cover by vegetation categories (quail foods, soft mast, and winter browse) indicate that ... trends in vegetation responses may be present. ... (Authors' abstract)

Citation Number 368

Witt, J. S. 1991. Forestry herbicides used for site preparation: effects on wildlife habitat. M.S. Thesis, University of Georgia, Athens. 79pp.

The effects of chemical and mechanical site preparation methods on wildlife habitat were studied on 3 Georgia Piedmont pine plantations 2-4 years post-treatment. Habitat components studied included percent coverage, and frequency of occurrence of 8 vegetation compositional groups and 3 wildlife food plant groups. Differences in occurrence and mean percent cover of all compositional and wildlife food plant groups were found among treatments within each age class. Results indicate that herbicide effects on cover and composition are temporary, with vegetation recovering within 3 years. However, within the first 3 years following herbicide treatment, it is possible for land managers to promote specific plant groups or species by selectively choosing herbicides. The vertical stratification of vegetation also was studied, and differences among treatments were found at 3 and 4 years post-treatment. (Author's abstract)

Citation Number 369

Witt, J. S., A. S. Johnson, K. V. Miller, J. J. Brooks, P. M. Dougherty, and P. S. Bush. 1993. Responses of wildlife plants to site-preparation in the Georgia Piedmont. Pp. 224-228 *in* D. H. Gjerstad, ed. Proceedings of the International Conference on Forest Vegetation and Management - Ecology, Practice, and Policy. Auburn University, School of Forestry Report 1993:1.

Vegetation was sampled on 3 loblolly pine (*Pinus taeda*) plantations [in the Piedmont region of Georgia] to evaluate the responses of wildlife food plants to various site preparation treatments at 2-4 years post-treatment. Treatments and years post-treatment included Arsenal (2 yr), Garlon 4 (3,4 yr), Tordon 101 + Garlon 4 (2,3 yr), Velpar L (2,3,4 yr), shear, rake, and chop (2,3 yr), and a control (2,3, 4 yr). ... Abundance of bobwhite quail (*Colinus virginianus*) food plants tended to be greatest on the Arsenal and mechanical treatments. Standing crop of winter browse was highest on the Velpar L and control treatments during year 2, on the Velpar L and Garlon 4 areas at 3 years post-treatment, and on the Velpar L-treated areas in the fourth year after treatment. Occurrence of soft mast producing species varied among treatments and age classes. Differences in vegetation composition and structure among site preparation treatments decreased as stand age increased. ... (Authors' abstract)

Citation Number 370

Wittie, R. D., and K. C. McDaniel. 1990. Pp. 174-179 *in* J. S. Krammes, tech. coord. Proceedings of the Symposium, Effects of Fire Management of Southwestern Natural Resources. United States Department of Agriculture, Forest Service, General Technical Report RM-191.

Spring burning of pinyon-oneseed juniper woodlands previously treated with tebuthiuron was evalutated to determine its effects on trees, associated shrubs and herbaceous vegetation. Pinyon pine (*Pinus edulls*) was more affected by herbicide and less affected by fire than was oneseed juniper (*Juniperus monosperma*). Canopy reductions were dependent on tree density and range site. Forage production

increased after herbicide and burning treatments whereas browse production declined. Seedling densities were consistent across sites but affected by herbicide and fire treatments. (Authors' abstract)

Citation Number 371
Worsham, A. D., R. F. Soots, and J. F. Parnell. 1974. Herbicides for vegetation management in restoring dredge islands as nesting sites for coastal nesting birds. Proceeding of the Southern Weed Science Society 27:298.

... Herbicide treatments were applied on a 6-year old dredge island [in North Carolina] in 1973 to determine the possibility of using soil-sterilant type herbicides to recreate bare and sparsely vegetated nesting habitats for birds. Simazine, prometone, a mixture of 4% bromacil and 6% diuron, tebuthiuron, karbutilate, and dichlobenil were applied. ... Substituted urea-containing herbicides were promising for complete vegetation control where saltmeadow cordgrass was dense. Thus the potential exists for use of herbicides on dredge islands to alter plant succession to favor nesting habitats for certain types of colonial shorebirds and wading birds. (Authors' abstract)

Citation Number 372
Young, J. A. 1983. Principles of weed control and plant manipulation. Pp. 6-10 *in* S. B. Monsen and N. Shaw, compilers. Managing Intermountain Rangeland-Improvement of Range and Wildlife Habitat. United States Department of Agriculture, Forest Service, General Technical Report INT-157.

Weed control and revegetation of degraded range sites is one of the most challenging tasks facing land managers. The manager must be able to assess the inherent potential for specific environmental situations to support and maintain plant growth. The land manager must also be able to assess the relative successional status of these environmental units. Any weed control treatment will initiate a dynamic successional plant response. The consequences of this response must be understood and directed toward desirable management goal or the weed control treatment will often lead to the establishment of a plant community less desirable than the treated one. (Authors' abstract)

Citation Number 373
Zedaker, S. M. 1991. Biodiversity: boom or bust for forest vegetation management? Proceedings of the Southern Weed Science Society 44:222-232.

[The author discusses the biodiversity issue and the potential impacts of its regulation on forest vegetation management, with implications on the use of herbicides and their impacts on maintaining vertebrate and invertebrate diversity.] (DLH abstract)

Citation Number 374
Zorb, G. L. 1956. Research progress report on chemical seedbed preparation for wildlife food patches. Down-To-Earth 12:8-9.

see Zorb et al. (1956)

Citation Number 375
Zorb, L., L. Ruch and R. G. Heath. 1956. Chemical seed preparation for game food patches. Proceedings of the North Central Weed Control Conference 13:27-28.

[Dalapon and 2,4-D were used in a series of tests to investigate the potential of chemical farming for the Michigan Department of Conservation's game food patch program. The results indicated that chemical techniques should make possible a streamlining of the Department's food patch program. Research results are encouraging; present techniques need refining.] (KVM abstract)

Citation Number 376

Zou, J., J. T. Flinders, H. L. Black, and S. G. Whisenant. 1989. Influence of experimental habitat manipulations on a desert rodent population in southern Utah. Great Basin Naturalist 49:435-448.

[The study investigates] ... how habitat manipulations in a black sagebrush (*Artemisia nova*)-dominated area ... affected resident desert rodent populations ... [including] the deer mouse (*Peromyscus maniculatus*), Great Basin pocket mouse (*Perognathus parvus*), sagebrush vole (*Lagurus curtatus*), Ord's kangaroo rat (*Dipodomys ordii*), and least chipmunk (*Eutamias minimus*). ... Habitat manipulations emphasized cutting of shrubs (rotobeating), treatment of plants with a herbicide (2,4-D), and reseeding with a mixture of grasses, forbs, and shrubs. Posttreatment trapping indicated the deer mouse was the most abundant rodent in treatment and control plots. Data indicate the prescribed habitat treatments had no significant negative effects on the deer mouse demes on the control or treatment plots. Habitat treatments [including herbicides] may have negatively impacted recruitment in pocket mice. Least chimpmunks were not captured in plots treated by rotobeating. [The] ... habitat manipulations may have contributed to interspecific competition in this rodent community through the reduction of both food and cover. (Authors' abstract)

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2,4,5-T [(2,4,5-trichlorophenoxy)acetic acid]
5, 11, 12, 13, 14, 15, 20, 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46 47, 49, 58, 59, 67, 72, 74, 83, 89, 96, 97, 98, 107, 113, 121, 122, 125, 130, 131, 133, 134, 135, 136, 145, 151, 152, 155, 156, 163, 165, 170, 175, 176, 181, 184, 182, 185, 190, 193, 195, 205, 207, 208, 211, 221, 250, 253, 254, 260, 262, 263, 268, 272, 276, 280, 282, 283, 289, 290, 291, 301, 314, 322, 335, 344, 345, 348, 352, 356, 357, 361

amitrole (3-amino-5-triazole); (3-amino-1,2,4-triazole)
9, 13, 107, 155, 195, 281, 318, 348

ammate (ammonium sulfamate)
30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40, 41, 42, 43, 44, 45, 46, 47, 49, 121, 213, 291, 316, 317, 344, 345

aquathol (see endothall)
343

atlacide (sodium chlorate)
317

atrazine [2-chloro-4-(ethylamino)-6-(isopropylamino)-s-triazine]
26, 27, 28, 58, 73, 91, 148, 195, 208, 348

bladex (2-[4chloro-6-(ethylamino)-s-triazin-2-amino]-2-methylpropionitrile)
195

bromacil (5-bromo-3-sec-butyl-6-methyluracil)
132, 371

CIPC [chloro isopropyl-(3 chlorophenol) carbamate]
137

CMU [3-(p-chlorophenyl)-1, 1-dimethylurea]
137

dalapon (2,2-dichloropropionic acid)
8, 9, 17, 58, 90, 117, 118, 166, 195, 213, 281, 314, 318, 341, 348, 374, 375

diclorprop [2-(2,4-dichlorophenoxy)propionic acid)
48, 50, 107, 155, 170

dicamba (3,4-dichloro-anisic acid)
119, 177, 178, 195, 348, 360

dichlobenil (2,6-dichlorobenzonitrile)
371

diuron [3-(3,4-dichlorophenyl)-1,1-dimethylurea]
132, 371

DN (2-sec-butyl-4,6 dinitrophenol)
137

endothal (3,6-endoxohexahydrophthalate)
137, 195

erbon [2-(2,4,5-trichlorophenoxy)ethyl 2,2-dichloro-propionate]
17, 281

fenac [(2,3,6-trichlorophenyl)acetic acid]
348

fenuron (3-phenyl-1,1-dimethylurea)
302, 344, 345

fluroxypyr (4-amino-3,5-dichloro-6-fluro-2-pyridyloxy-acitic acid)
244

fosamine (ammonium ethyl carbamoylphosphonate)
58, 233

glyphosate [N-(phosphonomethyl)glycine]
4, 7, 25, 58, 76, 81, 82, 92, 94, 95, 116, 123, 124, 147, 172, 174, 175, 176, 179, 198, 201, 212, 214, 222, 233, 236, 252, 257, 260, 277, 284, 285, 286, 287, 288, 308, 323, 324, 325, 326, 327, 328, 329, 330, 331, 332, 340, 348

hexazinone [3-cyclohexyl-6-(dimethylamino)-1-methyl-1,3,5 triazine-2,4 dione]
7, 22, 23, 24, 53, 54, 77, 78, 84, 85, 86, 132, 153, 158, 160, 162, 163, 233, 244, 248, 264, 265, 269, 279, 336, 338, 339, 364, 365

imazapyr (2-[4,5-dihydro-4-methyl-4 (1-methylethyl)-5-oxo-1H-imidazol-2-yl]-3-pyridine carboxylic acid)
53, 54, 77, 78, 159, 161, 163, 358, 153, 240, 248, 269, 279, 367, 369

karbutilate [m-(3,3-dimethylureido)phenyl-tert-butylcarbamate]
348, 371

MCPA [(4-chloro-o-tolyl)oxy]acetic acid; (2-methyl-4-chlorophenoxy-acetic acid)
29, 318

MCPB (4-[(4-chloro-o-tolyl)oxy]butyric acid); [4-(2-methyl-4-chloro-phenoxy)butyric acid]
29

mecoprop (2-(4-chloro-2-methylphenoxy)propionic acid); (2-[(4-chloro-o-tolyl)oxy]propionic acid)
29

metolachlor [2-chloro-N-(2-ethyl-6-methylphenyl-N-2,methoxy-1,methylethyl)acetamide]
132

MSMA (monosodium methanearsonate)
56, 233

oryzalin (3,5-dinitro-N4, N4-dipropylsulfanilamide)
132

oxyfluorfen ([2,chloro-1-(3-ethoxy-4-nitrophenoxy)-4-(trifluromethyl)benzene]
132

paraquat (1,1'dimethyl-4,4'-bipyridinium ion)
257

PBA (polychlorobenzoic acid)
348

picloram (4-amino-3,5,6-trichloropicolinic acid)
10, 12, 13, 14, 48, 50, 53, 54, 70, 72, 77, 78, 119, 194, 195, 208, 217, 225, 226, 227, 228, 229, 230, 231, 233, 241, 242, 244, 248, 269, 279, 320, 335, 339, 340, 348, 361, 367, 369

prometone [2,4-bis(isopropylamino)-6-methoxy-s-triazine]
371

radapon (see dalapon)
16, 19

simazine [2-chloro-4,6-bis(ethylamino)-5-triazine]
132, 192, 195, 199, 208, 233, 249, 314, 371

silvex [2-(2,4,5-trichlorophenoxy)propionic acid]
9, 10, 29, 107, 155, 170, 192, 195, 234, 319, 348, 349, 350, 351

tebuthiuron (N-[5-(1,1-dimethylethyl)-1,3,4-thiadiazol-2yl]-N, N-dimethylurea)
75, 99, 100, 101, 105, 119, 132, 210, 237, 238, 239, 266, 296, 297, 298, 300, 309, 310, 315, 321, 339, 340, 348, 366, 370, 371

TCA (sodium salt of trichloroacetic acid)
137, 166, 195

triclopyr ([(3,5,6-trichloro-2-pyridinyl)oxy]acetic acid)
7, 48, 53, 54, 59, 77, 78, 107, 210, 217, 222, 233, 237, 238, 239, 248, 257, 260, 269, 279, 296, 297, 309, 310, 348, 367, 369

ureabor (see bromacil)
281

APPENDIX I

Approved common names and product names of herbicides listed in this bibliography. Product names include most trade names and formulations of the listed herbicide. Product names are not an exhaustive list of available trade names; only the major names listed in the Farm Chemicals Handbook (1983), Weed Science Society of America Herbicide Handbook (1983), and USDA Forest Service Pesticide Background Statements are included.

2,3,6-TBA

Common Name: trichlorobenzoic acid
Product Names: Fen-all, TCBA, Trysben 200, Zobar

2,4-D

Common Name: 2,4-D
Product Names: Agrotectal, Amidox, Amoxone, Aqua-Kleen, Brush-Rhap, Chipco Turf Herbicide "D", Chloroxone, Crop Rider, Dacamine, Debroussaillant 600, Ded-Weed, Desormone, Dicotox, Dinoxol, DMA 4, Dormone, Emulsamine, Envert DT, Evert 171, Esteron 99 Concentrate, Esteron Four, Esteron Brush Killer, Estone, Farmco, Ferxone, Formula 40, Hedonol, Herbidal, Lawn-Keep, Macondray, Miracle, Plantgard, Rhodia, Salvo, Spritx-Hormin/2,4-D, Superormone Concentre, Super D Weedone, Transamine, Tributon, U 46, Wergemaster, Verton 2D, Visko-Rhap, Weed-B-Gon, Weedar, Weedatul, Weedone, Weed-Rhap, Weed Tox, Weedtrol

2,4,5-T

Common Name: 2,4,5-T
Product Names: Weedar, Weedone, Veon 245, Esteron 245 BE, Brush-Rhap A-4T, Brush-Rhap LV-OXY-4T

amitrole

Common Name: amitrole
Product Names: Amitrole-T, aminotriazole, Amizine (amitrole & simazine), Amizol, Fenamine (amitrole, fenac & atrazine)

ammate

Common Name: ammate
Product Names: Amcide, Ikurin, Sulfamate

aquathol see endothal

atlacide

Common Name: sodium chlorate
Product Names: Atlacide, De-fol-ate, Drexel Defol, Drop-leaf, Fall, Harvest-Aid,, Klorex, Kusatol, Rasikal, Tumbleaf

atrazine

Common Name: atrazine
Product Names: Aatrex 80W, Aatrex Nine-O, Aatrex 4L, Aatrex 4LC, Atratol 8P, Atratol 80W, Bicep 4.5L, Gesaprim, Lasso, Ramrod, Atrazine 4L Herbicide, Atrazine 80W Herbicide, CO-OP Liquid Atrazine, CO-OP Atrazine 80WP, CO-OP Atra-Pril 90% dry flowable

bladex

Common Name: cyanazine
Product Names: Bladex, SD 15418, WL 19805

bromacil

Common Name: bromacil
Product Names: Hyvar-X (80% bromacil). Hyvar-XL, Krovar I (40% bromacil, 40% diuron), Krovar II (53% bromacil, 27% diuron), Ureabor, Borocil (borate-bromacil), Urox B, Urox HA, Rout G-8 (bromacil-diuron)

CMU

Common Name: monuron
Product Names: Monurex, Telvar

CIPC

Common Name: chlorpropham
Product Names: Beet-kleen, Furloe, Sprout Nip, Spud-nic, Taterpex, Triherbide-CIPC, Unicrop CIPC

dalapon

Common Name: dalapon
Product Names: Dowpon (sodium salt), Dowpon M (sodium & magnesium salts), Radapon Liquid (sodium salt), Revenge, Dalapon 85

diclorprop

Common Name: dichlorprop, 2,4- DP
Product Names: Weedone 2,4-DP, Weedone 170, Envert 171, Cornox RK 64, Cornox RK,Tri-Cornox, Dichlorporp

dicamba

Common Name: dicamba
Product Names: Banvel D, Banvel 45, Banvel 4S, Banvel 4WS, Banvel II, Banvel CST, Tri-Cornox, Velsicol 58-CS-II

dichlobenil

Common Name: dichlobenil
Product Names: Casoron 133, Casoron G, Casoron G 20 Sr, Casoron G-4, Casoron W50, Casoron G-10

diuron

Common Name: diuron
Product Names: Karmex, Krovar I (40% diuron, 40% bromacil), Krovar II (27% diuron, 53% bromacil), Velpar K-4 (46.8% diuron, 13.2% hexazinone), Drexel Diuron 4L

DNBP

Common Name: dinitro, dinoseb
Product Names: Basanite, Caldon, Chemox General, Chemox PE, Chemsect DNBP, Dinitro, Dinitro-3, Dinitro General, Dynamyte, Elgetol 318, Gebutox, Hel-Fire, Kiloseb, Nitropone C, Premerge 3, Vertac Dinitro Weed Killer 5, Vertac General Weed Killer, Vertac Selective Weed Killer

endothal

Common Name: endothall, endothal
Product Names: Accelerate, Des-i-cate, Endothal Turf Herbicide, Endothal Weed Killer, Hydrothol 47, Hydrothol 191, Hydout, Aquathol K

erbon

Common Name: erbon
Product Names: Baron, Novege

fenac

Common Name: fenac, chlorfenac
Product Names: Fenatrol, Fenatrol Plus (fenac & 2,4-D), Fenavar (fenac, bromacil & amitrole), Fenavar Granular, Fenamine (fenac, atrazine & amitrole)

fenuron

Common Name: fenuron, trichloro-acetic acid
Product Names: GC 2603, Dozer

fluroxypyr

Common Name: fluroxypyr
Product Names: Starane

fosamine

Common Name: fosamine
Product Names: Krenite, Krenite S

glyphosate

Common Name: glyphosate
Product Names: Roundup, Rodeo, Glyphosate Technical, Accord, Vison

hexazinone

Common Name: hexazinone
Product Names: Velpar Weed Killer, Velpar Gridball, Velpar L, Velpar K, Bo-rid V-4, Mobley V-4, Pronone 10G

imazapyr
Common Name: imazapyr
Product Names: Arsenal

karbutilate
Common Name: karbutilate
Product Names: Tandex

MCPA
Common Name: MCPA, MCP, metaxon
Product Names: Chiptox, Rhomene, Rhonox, Dow MCP Amine Weed Killer, Weedar Sodium MCPA, Brominal Plus, Weedar MCPA Concentrate, Weedone MCPA Ester, MCP Amine 4

MCPB
Common Name: MCPB
Product Names: Can-trol, Thistrol

mecoprop
Common Name: mecoprop, MCPP
Product Names: Iso-Cornox 64, Chipco Turf Herbicide, MCPP K-4 CMPP (obsolete)

metolachlor
Common Name: metolachlor
Product Names: Dual 8E, Bicep 4.5L, Milocep 5L

MSMA
Common Name: MSMA
Product Names: Ansar 170 H.C., Ansar 529 H.C., Arsonate Liquid, Bueno 6, Daconate 6, Dal-e-rad, Herb-all, Merge 823, Mesamate, Monate, Phyban H.C., Target MSMA, Trans-vert, Weed-e-rad, Weed-hoe

oryzalin
Common Name: oryzalin
Product Names: Ryzelan, Surflan, Dirimal

oxyfluorfen
Common Name: oxyflurofen
Product Names: Goal 2EC, Goal 25W, Goal 1G, Goal 2G

paraquat
Common Name: paraquat
Product Names: Gramoxone, Ortho Paraquat

PBA
Common Name: PBA
Product Names: Benzac 354, Zobar

picloram
Common Name: picloram
Product Names: Tordon Beads, Tordon K, Tordon 10K, Tordon 22K, Tordon 101, Tordon 101R, Tordon 155, Tordon 212, Amdon, Grazon

prometone
Common Name: prometone
Product Names: Pramitol 25E, Pramitol 5PS, Pramitol 80WP, Conquer, Gesafram, Primator, CO-OP Pramitol 25E, CO-OP Pramitol 5PS

radapon see dalapon

simazine
Common Name: simazine
Product Names: Prencep 80W, Princep 4L, Princep 4G, Aquazine 80W, Princep Caliber 90, Gesatop, Rimatol, Simazine 4G

silvex
Common Name: silvex, fenoprop, 2,4,5-TP
Product Names: Kudon, 3D Weedone (2,4-D, silvex & dicamba), Weedone Chickweed Killer, Weedone 2,4,5-TP, SILVI-RHAP LV-4TP

tebuthiuron
Common Name: tebuthiuron
Product Names: Graslan, Spike, Herbic, Perflan

TCA
Common Name: TCA
Product Names: Hopkins Sodium TCA Weed Killer Liquid, Hopkins Sodium TCA Granular Grass Weed Killer, Revenge

triclopyr
Common Name: triclopyr
Product Names: Garlon 3A, Garlon 4, Dowco 233

ureabor see bromacil